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A MECHANICAL ENGINEERING SOCIETY is to be organized at a meeting of 25 representatives of the Department of Mechanical Engineering in almost as many different state colleges, to be held June 22 at the Ohio State University, Columbus, O. The object is to secure by co-operation and meetings for discuss on the best courses of study, methods of instruction, equipment, buildings, and in general the maximum efficiency of the mechanical engineering departments of all colleges which owe their existence in whole or in part to the act of Congress of July, 1862, known as an act donating public lands to the several states and territories. All persons interested are invited to take part in the movement. The Committee on Arrangements is as follows: S. W. ROBINSON, Columbus, O.; C. W. SCRIBNER, Ames, Ia.; O. P. WOOD, Manhattan, Kan.; Acting Secretary, A. J. WIECHARDT, Ames, Ia.

AUTOMATIC SIPHONS are to be used for the flush tanks of the sewers at Marion, O., and the Sewer Committee desires to have a competitive test made before the style of siphon is selected. Makers of these devices can address Mr. JOHN W. HILL, Consulting Engineer, Cincinnati, O., who will arrange for the tests. It is probable that the siphon adopted as a result of the test will be used in all the districts as the sewers are extended.

A BIG WATER SUPPLY SCHEME is on foot in California, which is promoted by the Blue Lakes Water Co., recently reorganized. The old company had about 70 miles of canals and owned water rights along the Mokelumne River and in Alpine Co. Water was furnished for use at quartz mines and mills and for the supply of town companies. The new company has a nominal capital stock of $10,000,000, one-half of which has been subscribed and $300,000 paid in. It is reported that the company proposes to lay a steel conduit 170 miles long and 6 ft. in diameter, for some distance at least, from Blue Lakes to supply water to Oakland, Sacramento, Stockton, San Jose and other cities and towns. The company proposes to sell water in quantities, delivered to reservoirs and not to consumers.

THE THIRD AVENUE RAILROAD COMPANY of New York has been granted permission by the State Railroad Commission to increase its capital from $2,000,000 to $5,000,000, for the purpose of changing from horses to cable power. The company is also impowered to issue $1,500,000 of first mortgage bonds, for the same purpose.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a combined rear collision and trestle failure on the Norfolk & Western R. R., near Luray, Va. A freight train had slowed down to cross a wooden trestle which is being replaced by an iron structure, and was passing over the trestle, when it was run into by a second freight train which had not slowed down. The shock caused the trestle to collapse, the caboose and two cars of the first train and the whole of the second train being thrown to the bottom of the ravine, a depth of nearly 70 ft. One man was killed and another fatally injured. The engineer of the second train stated that he whistled for brakes, but they were either out of order or were not applied.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: A wooden footbridge across Tuna Creek, at Bradford, Pa., gave way under a crowd coming from a baseball game, May 30. Eight persons were seriously injured. A trestle on the Canadian Pacific Ry. at Revelstoke, B. C., gave way, May 28, under a freight train, throwing the engine and 16 cars into the creek. One man was killed and 3 were injured. A trestle on the Union Pacific Ry., near Viento, Ore., was burned May 23, and several cars of a freight train went down and were burned. Several highway and railway bridges in Kansas, including 3 large ones on the Missouri Pacific Ry., were washed away by a flood, May 23.

A DRIVING WHEEL of a locomotive on the Maine Central R. R. broke May 25 while the engine was hauling a passenger train from Belfast to Burnham Junction. Both connecting rods were broken.

A PREMATURE BLAST in the Atlantic & Pacific mining tunnel near Silver Plume, Col., killed 4 men who were loading holes at the breast, 3,500 ft. from the mouth. The cause of the explosion is not known.

ANOTHER ST. LAWRENCE BRIDGE is promised, to span the river between Cape Vincent and Kingston, crossing Wolfe Island. The scheme is claimed to be promoted by the New York Central and Canadian Patific railways, as a means of running through trains from British Columbia to New York City.

ARTESIAN WATER FOR IRRIGATING RICE FIELDS is being tried along the coasts of lower South Carolina and Georgia. As is well known, the rice fields are flooded at planting time, and the planters are almost wholly dependent upon the state of the rivers for inundation. Press dispatches state that an experimental well has just been completed at Yemassee, S. C., the center of the lower California River rice region. This well is 6 ins. in diameter and at a depth of 53 ft. discharges 8 ft. above the surface, with a flow stated at 400 galls. a minute. Other wells range from 60 to 200 ft. in depth, and some have a much larger flow. If sufficient water can be obtained from artesian wells to flood the rice fields it is evident that great advantages will result from its use, as it will enable the planters to put in their rice when they see fit, without regard to the state of the rivers.

AN UNDERGROUND RAILWAY IS PROPOSED for Berlin. The tunnel would be driven by the freezing process of M. POETSCH, who would be himself the engineer of the tunnel. The motors used would be operated either by electricity or compressed air. The plans are now before the municipal government.

A 16-IN.-APERTURE TELESCOPE, the fifth largest in the United States, has been presented to Carlton College, Northfield, Minn., by Mr. E. H. WILLIAMS, of Philadelphia, who has already donated Williams Hall to this college. The aperture is 16 ins. in the clear and the focal length is 22½ ft. The instrument and its bearings weigh 27,000 lbs., and its largest single piece weighs 2,100 lbs. The crown lens is "Jena" glass, made in France, but finished in this country.

THE "HIGHEST" ELEVATED RAILWAY is to be built in Naples, to connect the central part of the city with the high ground back of the city. The road will rest on towers 328 ft. (100 m.) high, and elevators will carry the people to the stations. M. ADOLFO AVENO is the engineer, and the estimated cost is $1,000,000. The power used will be electricity, generated by a waterfall in the River Serreno.

BIDS FOR THE PROTECTED CRUISER No. 13 were opened on June 1, at Washington, D. C. The bids stood: Wm. Cramp & Son, Philadelphia, $2,745,000; Union Iron Works, San Francisco, $2,703,000; Bath Iron Works, Bath, Me., $2,690,000. This vessel will be similar to cruiser No. 12, equipped with one 8-in., two 6-in. and a great number of smaller rapid-fire and machine guns. She is designed for a speed of 22 knots per hour; and this speed is to be attained by the use of three sets of triple-expansion engines driving three screw propellers. It is expected that these ships will also develop a more economical cruising capacity at low speeds.

AIR-BRAKES ON STREET CARS are to be introduced on the electric railway of the Duquesne Traction Co., of Pittsburg. The cars are very heavy, and a small double-acting air-pump will be attached to one of the trucks and operated by a sprocket wheel and chain connected with one of the axles. This brake system is devised by General Manager SESSIONS, of the Pullman Palace Car Co.

THE GENERAL COMMITTEE OF ENGINEERING SOCIETIES, Columbian Exposition, effected a permanent organization at the meeting held in Chicago on May 15. Mr. O. CHANUTE was elected President of the permanent body, and Mr. E. L. CORTHELL, Chairman of the Executive Committee. The members of this Executive Committee are Messrs. E. L. CORTHELL, E. M. IZARD, WM. FORSYTH, C. L. STROBEL, ROBT. W. HUNT, JOHN W. CLOUD and D. J. WHITTEMORE. The purpose of this committee is to secure proper headquarters at the World's Fair of 1893 for members of all engineering societies in the world, and to promote an international congress of engineers to be held, at a date yet to be fixed, during the Exposition. The engineers will doubtless have a separate congress among the many world's congresses proposed.

DRIVEN-WELL POINTS with the strainer holes bushed with brass are in use at Brookline, Mass., having been put in by Mr. F. F. FORBES, Superintendent. The brass bushing was used to lessen the filling of the holes by rust. The work of perforating the pipe, as well as bushing it, was done by the employees of the water department. After tapping out the holes ¾-in. brass pipe are screwed in until flush with the inside of the strainer. Then the brass pipes are sawed off with a hack saw and smoothed so as not to interfere with the driving of the pipe. This method and further details regarding driven wells were described and discussed at a recent meeting of the New England Water-Works Association, and reported in the *Journal* of the association for March.

MUNICIPAL GOVERNMENT has been practically abolished in St. Petersburg, Russia, and hereafter the general government will control in all things. The old form is to some extent retained, but the municipal councils will meet only once in 4 months, instead of weekly. The change is due to too open discussion of public affairs by the old councils.

THE JETTY WORK ON TAMPICO BAR, TEXAS, is progressing favorably, says the New Orleans *Times-Democrat*. About 300 Americans and 1,200 Mexicans are employed. Each jetty is to be 7,000 ft. long and they will be 1,000 ft. apart. The north arm is now about 5,000 ft. and the south arm 3,000 ft. long. The effect upon the channel is already marked; and at 3,000 ft. from shore, where the double jetty ends an old-time channel of 8 ft. has deepened to 20 ft.

THE O'BRIEN & CLARK AQUEDUCT SUIT, wherein about $800,000 is claimed as due the contractors for extra work, false representations, change of plans, etc., was brought to a sudden check by the ruling of Judge INGRAHAM that the city was not responsible for any work done outside the contract. The effect of this ruling is to reduce to about $300,000 the claim upon which action can be sustained. The Judge will, however, hear further evidence from the counsel for the contractors, and the suit is continued.

Notes on the Nicaragua Canal.

At the time of our visit the main breakwater, commenced in December, 1889, extended about 1,150 ft. from the point of beginning. At the risk of repeating what has already been detailed in this journal in past issues, the work done can be described as follows: The total width of the pier is 42 ft., and the greater part is constructed by driving 12 piles across the width of the pier in bents 8 ft. apart. Each bent is capped by a 14 × 14 in. yellow pine timber secured to the piles by drift and screw bolts, and each bent is braced transversely by six 4 × 10 in. diagonal timbers, spiked to opposite sides of the piles. Securely bolted to these caps are eight 12 × 12 in. timbers running lengthwise with the pier. Along the two sides of the pier a solid wall is formed by driving piles between the bents and inside the box thus formed brush mattrasses are sunk by loading them with rock. This filling is intended to extend above high-water mark, and, except at the extreme seaward end, these mattrasses have already been filled solidly with sand, and the shore line on the windward side has been advanced in a long, flat curve 152 ft. since the date of beginning. A railway on the pier carries an ingeniously contrived jet-pile driving machine, which will be later described, and extends back, about one-quarter mile, to a wharf located in deep water on the lagoon. To prevent cutting behind the breakwater a wing-wall about 700 ft. long of sheet piling has been driven from the pier to the lagoon. As the sand is very hard, ordinary pile driving was practically impossible and the jet-pile driver has been used with eminent success.

The timber used in the piles and timbers of the breakwater is North Carolina pine, creosoted. The first—and fortunately a small—lot of piles were treated to 14 lbs. of oil per cu. ft. These piles have failed badly, some of them being eaten half off by the teredo in their one year of service. Since then all timbers used contain 16 lbs. of oil per cu. ft., and so far there is no evidence of failure.

The immediate effect of the building of this pier, before any dredging was done, was the natural cutting by the sea of a channel to the westward of the pier, about 600 ft. wide and with 6½ ft. of water at low tide. This channel has been maintained and some later dredging has opened a narrow channel with 10* ft. of water in it along the inside of the breakwater. The small breakwater to the west of the proposed entrance has also been commenced. At the time of our visit all work on the main breakwater had been suspended, awaiting the completion of a railway bridge now under construction, which will permit access to the first stone quarry inland from the sea. As soon as this stone can be reached, work will be resumed on the breakwater and the pier extended seaward with *pierre perdue* or massive rubble.

* Since writing this the sea has broken through the outer bar, and on May 20 a steamer drawing 12 ft. entered the harbor, and the hand-lead showed a continuous channel of 15 ft.—ED. ENG. NEWS.

The line of the canal is cleared inland for a distance of about 11 miles and for a width of 486 ft. The surface of this so-called swamp lies about 6 ft. above the present level of Greytown harbor, and two of the Slaven dredges have already made a cut into it 3,000 ft. long, 275 ft. wide and of an average depth of about 17 ft. below the water surface. The face of the cut thus being made promises well. The timber in this swamp, though sometimes as much as 4 ft. in diameter, is fitted by nature for growing upon a moist soil, and an anchorage is provided by wide spreading, buttressed roots running over the surface, rather than by the deep-penetrating, moisture-seeking roots of upland growth. This is a fortunate condition of affairs for the dredges, as the grubbing is practically reduced to surface work and the one tap-root is about all that gives any trouble. Another feature of importance is that the black, surface soil, the index of decayed vegetable matter and a bad thing to turn up and expose to the air, seems to be only from 12 to 18 ins. in depth. Below that comes a few feet of hard yellow clay, and then a stratum of unknown depth of a coarse, sharp and very heavy sand that is just what is wanted for a concrete ingredient. This sand is piled upon the sides of the cut from the conveyors of the dredges, and a Bay City steam shovel loads it on cars, and it is then used in making the railway embankment through the swamp that runs for some miles parallel to the canal line. The Nicaragua Canal Co. purchased last year from the American Dredging Co., of Panama fame, seven of the great dredges so effectively used on the Isthmus. Of these dredges, one, the Ferdinand de Lesseps, by a curious coincidence, was lost at sea on her way from Colon. Two of the remainder are hard at work in the canal and the rest are being refitted at the shops of the company in the harbor of Greytown. These dredges are, in all essential features, like the Hercules described and illustrated in ENGINEERING NEWS of Feb. 3, 1883, excepting that in the later-built dredges iron has been substituted for wood in the hulls and bucket and conveyor towers.

The City of Paris, now at work cutting the canal, is a type of the later dredges built. This dredge, cutting 14 ft. below water and 6 ft. above, over a path 130 ft. wide, in the material described, has averaged so far an advance, in 10 hours, of 20 to 25 ft. In this dredge the iron tower is 80 ft. above the water level, and the material lifted to that height is discharged onto the shore by a conveyor tube 165 ft. long, and this can be extended to 200 ft. Two 300-HP. engines supply the necessary power. Each bucket contains a cubic metre (1⅓ cu. yds.), and a count made at the time of our visit showed a constant procession of ascending buckets passing at the rate of 14 buckets per minute, or about 1,000 cu. yds. per hour. Of course every bucket is not full, roots have to be removed and the dredge must be shifted or swung to its work. But the City of Paris has an actual record of 10,600 measured cu. yds. of mud and sand dredged from the entrance to the harbor in 24 hours, and deposited 175 ft. away. In estimating the cost of dredging on this work the price was put at 25 cts. per cu. yd. The records kept here show that, excluding only interest on plant, the maximum cost has been 12 cts. per cu. yd., and the average cost is between 6 and 7 cts. These prices, however, are obtained from the first or surface cutting to a depth of 17 ft. To secure the final depths of 30 ft. the average cost will doubtless be increased.

RAILWAY THROUGH SWAMP BACK OF GREYTOWN, NICARAGUA. THE CORDUROY FOUNDATION.

From the harbor at Greytown, 10 miles out to the Divide, a railway for construction purposes has been very nearly completed. This road is located in the valley of the Deseado, and was built by Mr. C. P. TREAT, of Chicago, who commenced work in June, 1890. Work began in the rainy season, and much of the road was built in water from 2 to 4 ft. deep, under circumstances that called for the highest executive ability and the exercise of more patience, perseverance and skill in handling labor than usually fall to the contractor's lot. Surrounded as he was there by a swamp, camps had to be maintained, supplies brought in from Greytown, sick and wounded men cared for, and withal the Jamaica negroes had to be handled with much tact to induce them to do any efficient work under the conditions existing. That this road was built in good time and for almost half of its estimated cost is a sufficient indorsement of the organization and methods of its constructor. A corduroy of logs and brush was first laid down after the line had been cleared and the rails were laid on ties resting on longitudinal stringers of round wood. On the rough track so made filling material was hauled out later, until now the logs have been entirely hidden under an embankment of sand, the rails are well laid, switches and sidings have been provided, water tanks erected, and for 9½ miles there is an excellent single-track road of standard gage that would put to shame many a line in daily use in the States.

RAILWAY THROUGH SWAMP, BACK OF GREYTOWN. ROADBED BEING FILLED IN WITH SAND OVER CORDUROY FOUNDATION.

This railway is equipped with three locomotives of 36 to 50 tons and a number of platform cars, from which the sand ballast is removed by an "unloader." While we were there 7 trains per day of 13 cars each were carrying sand out on the track. At the harbor end of the railway is a fine wharf, 30 ft. wide by 264 ft. long, built of creosoted timber, and provided with a derrick and steam hoisting engine. At this same point a very well-equipped machine shop, 50 × 108 ft., has just been completed, with foundry, blacksmith and carpenter shops, paint and tool houses, etc. The company is now enabled to do upon the spot almost any description of work required. It might be mentioned that, while the estimated cost of this railway was $60,000 to $75,000 gold per mile, the actual cost was about $28,000 in the same currency. This latter

figure included all rolling stock, the sidings, etc. and material for another 1¼ mile of track.

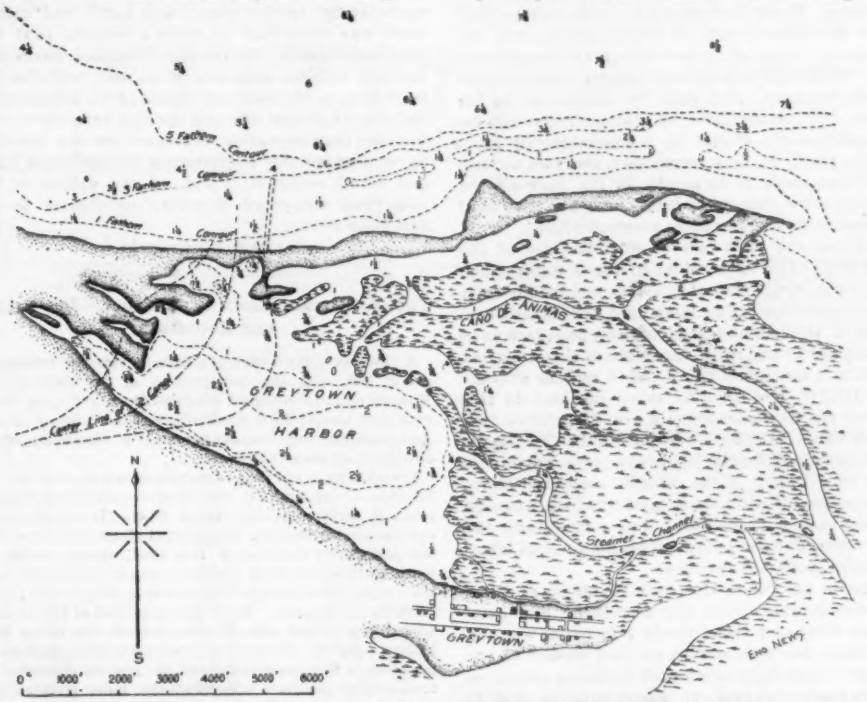
Steel pipe, 8 ins. in diameter, is already upon the line for conveying pure water from a point on the La Paz Creek, 115 ft. above tide, to the headquarters at America, 10 miles away. The pipe follows the railroad line most of the way, and the water supply thus obtained will still further assure good health on that part of the canal line where the present water is more or less contaminated by decaying vegetable matter.

Having now described as briefly as possible what we found about the Atlantic end of the canal, we can start out upon the trail leading across Nicaragua to the Pacific coast. But before doing so, some estimate of the work performed by the present engineering staff can be formed when it is stated that the office records show about 100 miles of surveyed line for every single mile of actual location. Over all important parts cross-sections have been taken at intervals of 100 ft., and in all cuttings diamond drill-borings have been made every 1,000 ft. The pains taken to secure the best and most economical locations, and to obtain all the data essential for close estimates of probable quantities, is the best index of the business-like methods of the present administration of the Nicaragua Canal Co.

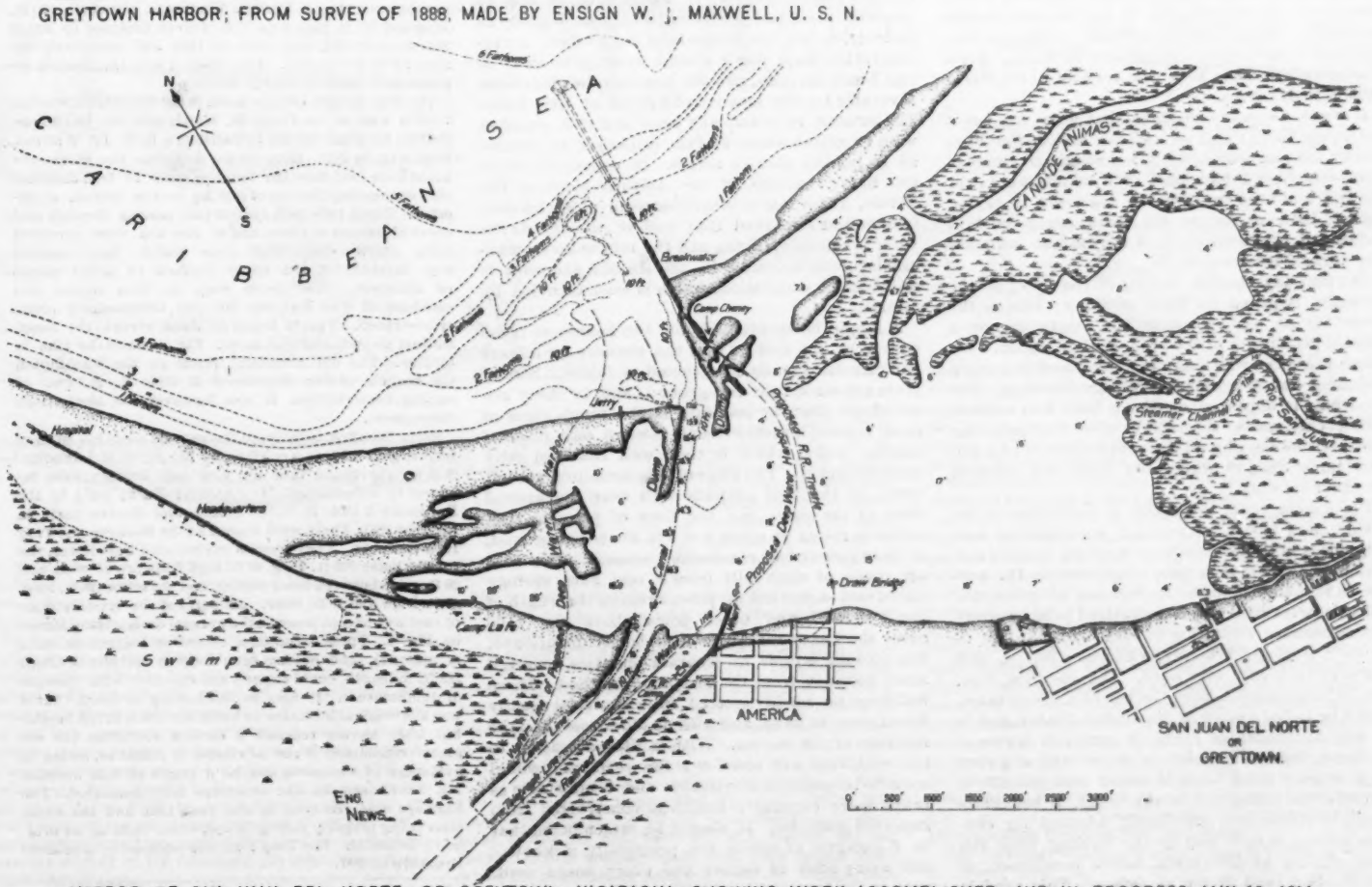
Upon April 8 Senator MILLER, Chief Engineer MENOCAL, Division Engineer DAVIS and Chiefs of Party MILLER and BENNETT started out from headquarters at America with the most of the Aguan party, whose names have already been given. Of the original party, urgent business required the immediate return to New York of Mr. SCRIBNER and Mr. MERRIAM, and ill-health necessitated the like departure of Mr. MCARTHUR, who was suffering from pneumonia while on Roncador Reef. Mr. WATROUS went around on the San Juan with the baggage of the party. Commander BROWNSON and Lieutenant CHAMBERS, of the U. S. S. Petrel, also accompanied us, the latter being already familiar with the route as a member of one of the surverys made under the auspices of the U. S. Navy Department. Chief Surgeon STUBBERT and his assistant Dr. MENOCAL were with us in their official capacity, equipped with a medicine chest well filled for any emergency. Each member of the party had been provided with a rubber blanket, a heavy woolen blanket, a rubber pillow that could be inflated and a close, heavy mosquito bar. What little else was carried, in the form of pajamas, an extra woolen shirt, comb, and brush, etc., were wrapped up in the blankets. These articles, together with all the food we were to consume in a three-days' tramp, were put up into convenient packs and carried on the backs of about 30 sturdy natives.

Rain commenced to fall before we boarded the train upon which we were transported to the end of the track, but every one was prepared for "experiences," and took these bravely as they occurred. At the terminus of the railway track a mule was unloaded that some kind friend in Greytown had insisted upon providing for Senator MILLER. But, unfortunately, the track ended at a crossing of the Deseado, and, as the beast could not climb the log provided nor go down the steep banks and through the deep mud, the Senator peremptorily ordered the return of the mule to its owner, and bravely trudged along on foot.

The trail we followed was rough enough in many places, for it was simply a pathway chopped through the jungle with a *machete*, or long native wood knife, and not too recently cleared. Streams were



GREYTOWN HARBOR; FROM SURVEY OF 1888, MADE BY ENSIGN W. J. MAXWELL, U. S. N.



HARBOR OF SAN JUAN DEL NORTE, OR GREYTOWN, NICARAGUA, SHOWING WORK ACCOMPLISHED AND IN PROGRESS, MAY 18, 1891.

There is now a continuous 18-ft. channel from deep water into the harbor.

at first frequent, and had to be waded, or crossed on logs and fallen trees where mud and water were too deep. Vines tripped the unwary by the heels or throttled them around the neck, and in addition to all these and lesser trials the "tenderfeet" of the party were constantly on the lookout for snakes of deadly breed and wondrous size; for alligator ants whose bite was "to paralyze" the victim; for wood-ticks and "jiggers," and a number of other vicious beasts and insects of which we had heard so much at home, and from the "truthful James" of the engineering staff previous to our departure from head-quarters.

We might as well confess right here that we found our own fears in this particular direction unrealized. The only deadly snake met with on this tramp of over 40 miles through a virgin tropical jungle was one *toboba*, and that was killed by the writer. But it requires more than average moral courage, when a snake story is in question, to admit that this particular deadly serpent was only 15 ins. long, and met its untimely end while industriously trying to get out of our way. Of alligator and other ants we saw any number, and it was only wise to look sharply at a log before you sat upon it, and even while you rested. One of the newspaper men in our party interviewed an alligator ant for a brief moment, and remarked that for the rest of the day he felt as if his hand was being forcibly pressed upon the business end of a tack. The sensation was certainly unpleasant, but we can certify that he was the most active "paralytic" we ever encountered. Of *garapatas*, or wood ticks, and of jiggers, some few were collected and for a time concealed about the persons of members of the party; but aside from some annoyance no particular harm resulted. In fact it was more than once remarked by several frequenters of the Adirondack forests with us that there were more annoying flies and vermin of this kind in one acre of the New York woods than in a square mile of this virgin Nicaraguan jungle. At night, in the camps, a few mosquitoes made their appearance, but one hungry specimen from the coasts of New Jersey would have put them all to shame as far as "business" was concerned. We soon found that the thick mosquito nets provided were really intended not to keep away mosquitoes, but to protect the sleeper against the damp night air prevalent in this section, and which would doubtless in time do harm. For a similar reason these nets are used by all the workmen in their camps.

It is not necessary to state that ours was not a surveying party; and we neither tested the lines run by the engineering staff nor sought to improve upon established locations. We merely went over the trail and used our eyes as engineers in spying out the land—as far as we could see it—and in judging of the conditions as they might influence the work of construction.

The first day's march, mainly in the valley of the Deseado, required no hard climbing; but as the Great Divide was approached we began to note a decided peculiarity in the hills of this region. We found these as a rule sharp in outline and very steep and much cut up by lateral drainage channels. The soil where it appeared on these hills was a red or yellow clay, made slippery by the ever-recurring showers, and bearing all the characteristics of a material impervious to water, and thus well adapted for canal building.

The harder rock, found only in the 3 miles of the Divide, was basalt, of varying composition; and in the beds of the streams were large water worn and rounded bowlders that were roughened on the surface so that they bore the appearance of gritstone. But this latter rock was also declared to be a variety of the basaltic formation by Maj. DUTTON, late of the U. S. Geological Survey, who was with us, and it was undoubtedly very hard. The so-called *tepetate*, as it appeared here in the banks of the streams, would be called a slate in the United States, and is in fact an indurated clay. It varies in degree of hardness, but will doubtless stand well at a very steep slope. Good sand is found near the site of several of the locks; and, in any event, a boundless supply of this article, excellently adapted for concrete mixing, is to be had for the hauling from the canal cutting at Greytown, before mentioned, or from the San Juan River at Ochoa. This sand is coarse and sharp.

The trees in this section are plentiful and quite large, rarely exceeding 2½ ft. in diameter, however, and they are generally soft and easily cut, as far as the wood is concerned. The undergrowth will be troublesome from its density and quantity, but a gang of natives with their *machetes* would readily clear it out.

North of the Divide cut there are several streams of considerable volume in the rainy seasons which must be diverted. Surveys made show that some of these can be readily turned to the west and into the San Francisco basin, over a generally level piece of highland country; and by a short tunnel others can be taken to the east, and, through the Deseado, led into the basin. These streams are well adapted for utilization as a water power for drilling purposes in the Divide cut, a head of not less than 100 ft. being available. With the deep narrow valleys characteristic of this country, and rock in abundance at the Divide, the construction of storage reservoirs for hydraulic power should be a comparatively inexpensive task. In this connection, the fact already noted that there is no month in the year on the Atlantic slope without at least one heavy rain is of importance in keeping these reservoirs full.

As 21% of the total excavation on the line of the canal will have to be done in the 3 miles which include the Divide cut, this will be one of the chief points for concentrating labor, and the health conditions of the neighborhood are essential factors in the economical and rapid execution of this work. At this point a maximum cut of 298 ft. and an average cut of 111.2 ft. over the 2.917 miles included in this division means the removal of over 7,000,000 cu. yds. of rock and 3,000,000 cu. yds. of earth. To handle this material efficiently requires a large amount of power and drilling plant, almost unlimited transportation facilities, for about all of this rock is needed for the various "rock-fill" dams, locks and the breakwater, and a consequently large force of laborers, their camps and supplies.

There is no doubt that this Divide cuts off to a very considerable extent the refreshing and ever-blowing northeast trade winds, a fact that was evident to our party as soon as we had passed to the west, and these hills intervened between ourselves and the Caribbean Sea. It would thus be best to pitch the main and permanent camp as high up as possible, or on the summit of the Divide. Fortunately the crest line is almost exactly midway in this 3-mile division, and the general conditions seem favorable for the location of a camp at that point. The summit is practically level and well supplied with excellent water, and the railway is so located as to readily furnish access. In connection with the heavy rainfall of the Atlantic slope of the Divide, which might otherwise seem objectionable, it should be remarked that east of the Divide the work is chiefly dredging and the minimum of manual labor is required; in the Divide the work is mainly rock excavation, which is least troubled by rainfall.

It might be mentioned for the benefit of those who were not with us that the shelters for officers and men are usually constructed as follows: Strong posts are sunk into the ground, and to these are attached, often by lashings of the tough vines of these forests, a rather steeply pitched roof made of smaller poles, which is then well thatched with palm branches. The sides of this structure are left open, as the roof projects well over the ground lines of the house; but the floor of poles or split palms is raised up about 4 or 5 ft. above the ground, so as to permit free ventilation beneath. The beds are made of slats split from a very hard, springy palm, and supported on poles running the length of the "shack," and other poles above the beds carry the heavy mosquito nets before mentioned. The cooking is done in separate shanties, removed some distance from the sleeping quarters. These buildings are readily erected from material usually found close at hand, and with no other tool than the *machete* of the native. With a little attention to the roof, they will last for a few years, and would seem to be quite as serviceable and comfortable as much more expensive buildings constructed from imported material. It should be remembered that in Nicaragua sawmills are practically unknown; and every stick of timber and every board used, even in the larger cities, is either cut and adzed to shape or separated by the old-fashioned whip-saw. In handling large logs, the log is set up on a rude trestle as a substitute for the "saw-pit" of our ancestors.

As railway communication with the Atlantic seacoast is of the first importance, and must necessarily precede in its construction any work upon the Divide, the engineers have located these roads clear to the Ochoa Dam, as will be shown later on a general map of the canal, showing the later revisions of the line. In many places two lines of railway have been located; one, a permanent road, situated above the flowage line of the completed canal, and another nearer to points of actual work and intended only for construction purposes. These surveys were exceedingly troublesome; and hard and careful work was demanded to make a location that was at all practicable. In the San Francisco basin this railway follows generally what may be called the crest line, or the southern limits of the flooded area, between the canal line and the San Juan River. By so doing transportation is secured for the material to be used in the construction of the dams, large and small, required to cut off the valleys of the somewhat numerous northern tributaries to the San Juan River.

(To be continued.)

The American Railway Viaduct.—Its Origin and Evolution.*

A new era in the design of a certain type of bridge began in 1863, with the construction of the Bullock Pen Viaduct on the Cincinnati & Louisville Short Line Railroad, now Louisville & Nashville, and the history of the American Railway Viaduct is mainly a statement of its development since that time.

The viaduct is not the production of any single man. It followed a very gradual course of development, suggestions of certain features being distinctly traced to the earliest timber trestles. The general plan of these trestles was practically the same as now used, being formed of bents stationed at short intervals, connected together at their tops and at intermediate joints by longitudinal lines of stringers or struts. Each bent consisted of two or four legs with cap and sill, all cross-braced, the outer legs having a batter. Of course as the depths of ravines or depressions to be crossed increased, the general character of trestles was modified somewhat, the most striking example being the old Portage Viaduct, a structure 800 ft. long and 231 ft. high from bed of river, designed by SILAS SEYMOUR in 1851, and built in 1852, and completely destroyed by fire in 1875. This viaduct was the boldest attempt ever made in timber trestles.

The first notable change made in the established wooden trestle was in the Carey St. trestle over the Baltimore & Ohio Railroad tracks in Baltimore, built by WENDAL BOLLMAN, in 1851. Here for the first time the successive bents were held together longitudinally by iron diagonal rods connecting the top of one leg to the bottom of another. These rods took hold of pins passing through cast shoes at bottom of posts, and at the top were provided with screw ends and nuts which bore against cast washers on the upper surface of chord pieces or stringers. The bents were in two stories and consisted of two legs, cap, sill and intermediate strut, cross-braced, all parts being of wood except the longitudinal tie rods and cast shoes. Fig. 4 shows the plan in outline. The old Antietam trestle on the Washington Co. branch of the Baltimore & Ohio R. R. was of similar construction. It was, however, two stories high throughout.

Since "the first impulse to the general adoption of iron for railroad bridges was given by Mr. BENJ. H. LATROBE" it is not surprising that the first iron trestles were designed by his assistant, Mr. ALBERT FINK, built by the Baltimore & Ohio R. R. Co. in 1852, and erected early in the year 1853. These were known as the Buckeye and Tray Run viaducts. They crossed ravines on Cheat River, the former being 350 ft. long, 46 ft. high from top of wall, and 28 ft. wide between hand-railing, and the latter 445 ft. long, 58 ft. high and 28 ft. wide. All parts of the trestles were of cast iron except tie-rods, the general design being shown on Fig. 1. These structures rested on continuous walls of masonry, and having been built in sections of about 125 ft. in length, could expand and contract with changes of temperature. It may be interesting to learn that it was the original intention to build the walls to full height but after having reached a certain elevation the engineer considered it not advisable to continue, owing to evidences of weakness, and as a result of this decision Mr. FINK designed the structure here described. The Buckeye was removed in the year 1884, and the walls, after being properly strengthened, were built up as originally intended. The Tray Run was replaced by a modern structure in 1887.

*Abstracted from a paper by Mr. J. E. GREINER read before the American Society of Civil Engineers at the Lookout Mountain Convention.

In 1852 a tower lighthouse at Cary's Fort reef was designed. This was composed of four columns, one at each angle, connected together in all directions by struts and rods in the same general manner as are the towers of viaducts built at the present time. The tower was of two or more stories, and the posts or legs had a batter both longitudinally and transversely instead of being battered in a transverse direction only, as now adopted for viaducts. The lighthouses at Sand Key, designed in 1853, Sombrero Key (Dry Dock 1857), Shell Keys and Alchapalaya, in 1859, were of similar construction.

The Crumlin Viaduct, begun in 1853 and completed in 1857, on the Taff Vale Extension Railway, South Wales, Messrs. LIDDELL and GORDON engineers, is in all probability the first iron viaduct resting on independent iron towers. The main part of the viaduct consists of 7 spans of wrought-iron Warren girders 150 ft. center to center, and 6 towers arranged in tiers, each containing 14 cast-iron columns. The greatest height above surface of water is about 200 ft. A section of this viaduct is shown in Fig. 2.

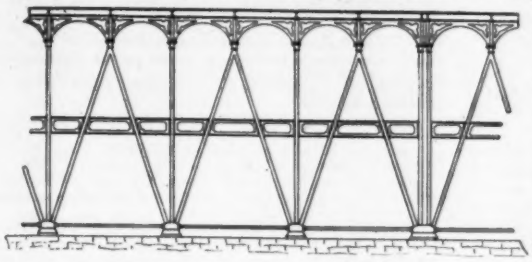
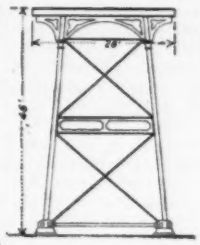


Fig. 1



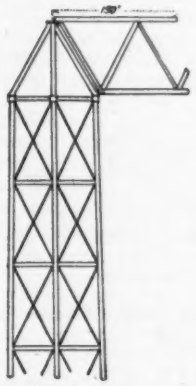


Fig. 2.

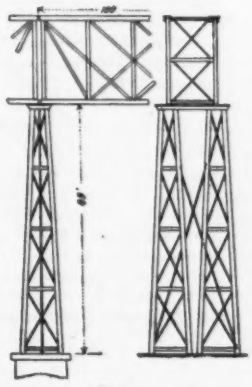


Fig. 3.

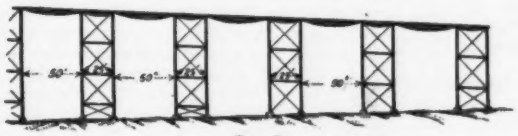


Fig. 7.

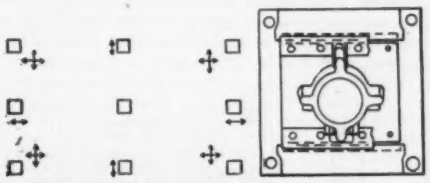


Fig. 10.

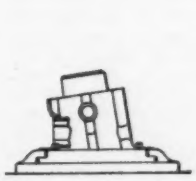


Fig. 11.

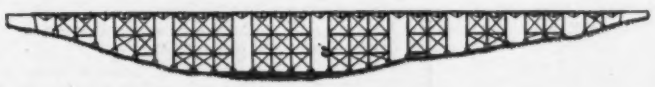


Fig. 12.

Fig. 3 gives an outline sketch of the iron structure over Jordan Creek, on the Catasauqua & Fogelsville R. R., designed and built by the late Mr. F. C. LOWTHORP in 1856 and 1857. The total length was 1,122 ft., consisting of 9 spans of 100 ft. each and 2 spans of 111 ft. each, supported on cast-iron trestle towers about 89 ft. high. All compression members were of cast iron, and tension members of wrought-iron rods, capable of adjustment. In 1889 the Catasauqua & Fogelsville R. R. were hauling cars weighing, when loaded, 88,500 lbs., and not feeling safe with such heavy loads on the old bridge, they had it replaced by a more modern structure, resting, however, on the original masonry erected by Mr. Lowthorp, the only change being 3 new coping stones.

From 1857 to 1868 there were no material improvements made in the general design of viaducts superior to those embodied in the Crumlin and Jordan River structures, and in these cases, it will be noticed, the towers were grouped together on top of solid masonry piers. These piers, being massive, required great care in preparing safe foundations in unfavorable situations, and, besides, were quite expensive. Engineers, therefore, began to study more closely the principles of engineering in relation to iron viaducts, and directed their attention toward designing a system of iron piers which should be of cheap construction, adapted to all conditions.

The first evidence of the result of such investigations is seen in the Bullock Pen Viaduct, designed by Smith, Latrobe & Co. in 1867, built in the same year, and erected on the Cincinnati & Louisville Short Line, now Louisville & Nashville, in 1868. The structure was 470 ft. long, the maximum height 60 ft., and of the general design outlined in Fig. 4. [These dimensions do not check with the drawing.—ED.] Mr. FREDERICK H. SMITH, M. Am. Soc., C. E., of the firm of Smith, Latrobe & Co., made the plan, although there were suggestions from and consultations with both C. SHALER SMITH and C. H. LATROBE. Mr. F. H. SMITH, however, considered that he originated certain features entirely independent of any other assistance, claiming as new and patenting several features thereof [of which we omit details.—ED.]

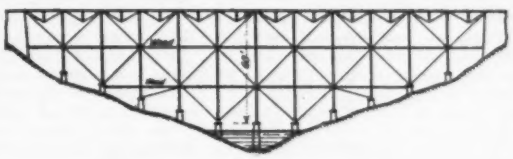
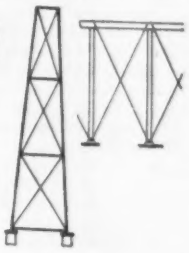


Fig. 4.



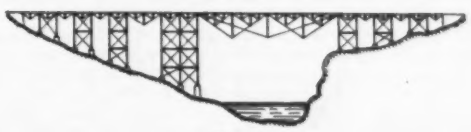


Fig. 6.

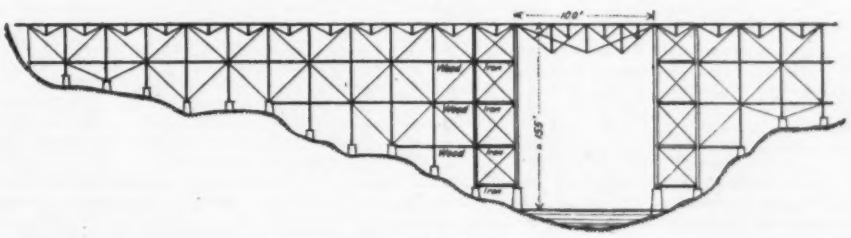


Fig. 5.

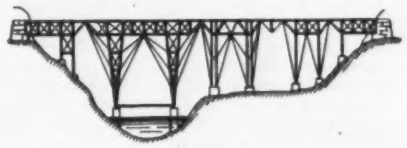


Fig. 8.

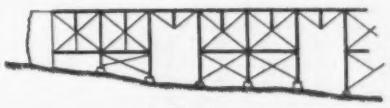


Fig. 9.

Fig. 13.

Fig. 14.

The firm was building five other viaducts about the same time for the same road, all of the general style of the Bullock Pen.

The Running Water Viaduct, on the Nashville & Chattanooga R. R., erected in 1869, and the Lyon Brook Viaduct, on the New York & Oswego Midland R. R., Fig. 5, built by the same company about the same time, were similar in design, the former consisting of one Fink span of 95 ft. and 692 ft. of trestling, the maximum height being 115 ft., and the latter of one span 100 ft. long and 720 feet of trestling, the maximum height being 155 ft. In these two structures the longitudinal diagonal bracing and timber strutting do not extend from abutment to abutment, as was the case in C. & L. S. L. trestles, but the ends of the long channel spans rest upon trestle bents which are connected to adjacent bents by wrought-iron struts and tie-rods, thereby forming complete iron towers of two bents each, with a 30-ft. tower span between the bents. In these structures there appears for the first time the common tower, composed of two bents of two legs each, braced together in all directions, the legs having a transverse batter only, and the bents being connected at their tops by a free or swinging span. This is the typical braced tower as used in American viaducts, and its use in these cases was not due to orginality of conception so much as to the necessity of the cases, which demanded a pier stable in itself at each end of the long span for the continuous lines of longitudinal strutting to bear against, since at that time it was thought essential to continue such strutting from abutment to abutment. By using these braced towers the structure was practically composed of two trestles, each of which was complete in itself, but connected by an open span so as to form one whole.

The features in the foregoing trestles, which were original with Messrs. SMITH and LATROBE, were: 1. Cast-iron foot-boxes interposed between and forming the bearings for column sections, in combination with longitudinal diagonal ties connecting the joints of any one tier with those of another tier. 2. The construction of the cast-iron postcaps, footboxes and joint boxes. 3. The combination of a series of independent or isolated bridge piers, with an intermediate span or spans of truss connecting the same. 4. Yoke and screw end attachment for longitudinal diagonal ties.

Messrs. SMITH, LATROBE & SMITH, up to this time (1869), believed that it was quite necessary to make the continuous longitudinal struts of wood in order to prevent the contraction and expansion which would follow the use of a similar system of iron struts; but in the design of the towers at ends of channel span in the before-mentioned Running Water and Lyon Brook trestles Mr. C. SHALER SMITH conceived and patented a means of doing away with wooden struts and substituting iron in their place, and in a general design of a viaduct made in 1870 he contemplated the use of iron throughout, and provided for expansion and contraction by omitting all bracing in certain panels or bays, thus forming a structure "made up of fixed piers composed of any number of panels of trestles alternating with spans of truss having one or both ends loose, so as to permit of contraction or expansion." Fig. 6 is a copy of this general design which accompanied his application for the patent, No. 111,010.

The Verrugas Viaduct, on the Lima & Oroya R. R., in Peru, built in 1871 by the Baltimore Bridge Co. and designed by Associate Engineer C. H. LATROBE personally, was the first wrought-iron structure built by the company embodying the principle of independent braced piers as set forth in Mr. C. S.

SMITH's specifications. This structure was 575 ft. long and the central pier was 252 ft. high, the others being 146 ft. and 179 ft. A full description of the structure and the cause of its collapse in 1889 may be found in ENGINEERING NEWS of July 27, 1889, and Dec. 27, 1890.

These structures, as built by the Baltimore Bridge Co., became very popular. In less than five years after the Bullock Pen Viaduct was erected, the company had built over 15,000 lin. ft. of railway viaducts.

In 1869 Mr. THOS. C. CLARKE, M. Am. Soc. C. E., designed a viaduct approach for the proposed bridge across Blackwell's Island, New York (Fig. 7). In a recent paper read before the American Society of Mechanical Engineers he states that at that time, not wishing to use any perishable material like wood, the difficulty arising from changes of length due to changes in temperature was avoided by simply leaving out the longitudinal bracing and struts of each alternate bay, thereby giving a series of braced towers 30 ft. long, connected by girders of the same length resting on their tops, and having a sliding motion at one end. He afterward found it expedient to lengthen these intermediate girder spans to the greatest length that could be transported from the shops to the site, about 60 ft., and believes himself to be the originator of the present type of railway viaduct. This may be the case, but it will be remembered that about the same time that Mr. CLARKE made his design for the approach of the Blackwell's Island Bridge, "which, however, was not built," Mr. C. SHALER SMITH had made application for letters patent for precisely the same kind of a structure, and, although Mr. CLARKE may have at a later day considered it advisable to increase the length of spans to the greatest that could be shipped in one piece to the bridge site, yet this cannot be considered as particularly original, since there was no fixed length either for open spans or those resting directly on towers, although it must be confessed, as a general rule, spans were made about 20 ft. wherever practicable.

About the same time (1870) Mr. C. BENDER secured letters patent on the type of viaduct shown in Fig. 8, and modestly claimed that he could build such a bridge "cheaper and more perfect than any other one in existence." He seems to have gotten the idea of his design from an ordinary kitchen table, and refers to the spans with overhanging ends as "table spans." This system differs from those previously designed, by combining the piers or trestles with the spans themselves, thereby using the stiffness of the truss itself against flexure, as the element of stability, "likewise as the frame of the common table keeps in position the table legs." If any such structure has ever been built in this country the author has been unable to ascertain when or where. This invention is mentioned here not because it in any way contributed to the evolution of the typical viaduct, but merely as showing the general aim of engineers at this time.

In 1871 Mr. EDWARD SERRELL, of New York, invented some improvements in iron viaducts, and claimed as his invention a "metallic tower made of columns around a central column that is permanently attached to the foundation, and the surrounding columns are provided with footplates in shoes that are attached to the foundation so as to allow for expansion and contraction, but to hold the parts properly in position." Details of this arrangement are shown in Fig. 9. The most interesting part of Mr. SERRELL'S design is his method of providing for expansion, as can be seen from Fig. 10, where the arrows indicate the direction of motion, and Fig. 11 the method of keeping this motion in a straight line. The principle shown in these sketches is now quite commonly used at sliding ends of plate girders and stringers, and the same could be applied with great advantage to the alinement of viaducts if in a four-legged tower one column be permanently fixed and the others be allowed to move in direction shown by arrows in Fig. 10. The author does not know whether the application of the principle of sliding motion shown in Fig. 10 has ever been used on viaducts, and believes that the double motion obtained by the arrangement shown is new, although there are other means of providing for sliding of legs, all more or less satisfactory.

In 1875 Mr. G. BOUSCAREN built his first viaduct on the Cincinnati Southern R. R. This is known as the Horseshoe Run Viaduct (Fig. 12), and was made in imitation of similar structures built by the Baltimore Bridge Co. Mr. BOUSCAREN consulted with Mr. C. S. SMITH at the time, and the latter still considered it essential to have a continuous line of diagonal rods from the top of the first to the feet of the last trestle bent in the group, thus making the number of bents in any particular group dependent on the height. In 1876 Mr. BOUSCAREN modified this design and adopted braced piers composed of two trestle bents only, braced together in all directions, no matter what was the height of the structure. The foot of one post was fixed to the masonry of the pedestal, and the other three were allowed to move on friction plates with the changes of temperature. This was a very marked improvement over previous types, inasmuch as Mr. BOUSCAREN avoided the necessity of frequent readjustment of diagonal bracing rods. Fishing Creek Viaduct (Fig. 13), built in 1876, is the first of its type. In 1878 he made an additional advance in the economy of the design by proportioning length of span between piers to the height of the structure; McKee's Branch Viaduct (Fig. 14) is an example of this type. In 1881 the same engineer designed for the same road the first viaduct on rocker piers, made of a single trestle hinged at both ends. Mr. BOUSCAREN considers that this type is far superior to all others when circumstances will permit of its use. The transmission of stresses is more direct (no adjustment whatever is necessary), and the stresses are more uniform and better defined than in any previously designed structures. The pin-bearing shoes, at the feet of trestle posts on one side are fixed to the masonry pedestals, and those on the other side are free to move on friction plates. Mr. BOUSCAREN has watched the action of both types of structure under the passage of heavy trains, and is satisfied of the superior merits of the later type. He has not taken out patents; it is therefore open to any engineer who wishes to put in practice the fundamental principle of engineering of meeting all requirements satisfactorily with the least expenditure of money.

A great number of viaducts copied from those designed by C. S. SMITH and G. BOUSCAREN have been built; but the greatest height of towers yet attained seems to have been in the Kinzua viaduct, where the greatest height of any tower is 297 ft., or from base of rail 301 ft. This viaduct was built by Clarke, Reeves & Co., in 1882.

The new Portage viaduct, G. S. MORISON, Engineer, built in 1875, if not the very first, seems to be the first of particular note which had towers of two bents only for the different lengths of spans. This structure replaced the old wooden viaduct, some of the original piers being used. The old piers being 50 ft., center to center, the designer could have made all spans 50 ft., but considered the adopted arrangement of 50 ft. piers and 100 ft. span preferable. This type of structure therefore antedates by several years similar types designed by G. BOUSCAREN for the Cincinnati Southern R. R.

Since the year 1878 general designs have been practically uniform, embodying the distinctive features which make such structures the most economical; but the Kinzua, so often spoken of and illustrated as a striking example, still holds its own against all comers for best adaptation of design to existing circumstances.

The Bullock Pen trestle was the beginning of a new era, and it must be acknowledged that Mr. F. H. SMITH, not C. SHALER SMITH, was the actual designer and should have full credit for introducing a new combination, therefore a practically new style of structure, in wrought iron. Mr. C. S. SMITH, however, was closely connected with this work, and the trestle has one feature, namely, the connection of the longitudinal diagonal bracing with intermediate joints on the columns, which was suggested by him. F. H. SMITH introduced the continuous line of timber strutting which anchored the bents to masonry abutments. In the Running Water and Lyon Brook structures, the distinctive feature is the complete iron tower composed of two bents of four legs each, braced in all directions by iron rods and iron struts, besides having a regular span to connect the bents which form a tower, originated by C. S. SMITH.

In conclusion, the author calls attention to the loose way in which the terms "trestle" and "viaduct" are applied, even by intelligent engineers. The usual definition of a viaduct is "a bridge of any style which carries a road over a ravine or depression where there is little or no water." A definition of a trestle would be practically the same with a limit to the style, although we feel instinctively, as it were, that the term "trestle," applied to the Kinzua viaduct, would be a misnomer. Where, then, does the trestle end and the viaduct begin? The derivation of the words will not help us, and it seems preferable that the name should designate the style rather than the location. In this sense a *trestle* would be a bridge of wood or metal in which the different spans are supported directly upon trestle-bents not connected in groups or towers; and a *viaduct*, a bridge of wood or metal in which the different spans are supported directly upon legs of towers composed of two or more bents braced together in all directions. The above definitions, while not meeting English practice, will undoubtedly distinguish American structures, and if adopted would do away with all looseness of nomenclature in this connection.

The New West Side Rapid Transit Line for New York City.

After several months' study and investigation the Rapid Transit Commission of New York City has adopted a series of resolutions embodying their decision on some of the fundamental questions before them. These resolutions are as follows:

Resolved, That after a thorough investigation, it is the sense of this board that any additional rapid transit system for the city of New York should embrace the following essential features:

1. That it should be such as to provide not only for present needs, but also be susceptible by additions, and not by radical changes or alterations, of such expansion as the future growth of the city may require.

2. That it should provide for express trains at high speed for long distances and for way service for intermediate distances upon separate tracks so located as to facilitate at proper intervals an exchange from express to local and from local to express trains.

3. That the surface of the streets and avenues in the city should be obstructed to the least possible extent, and that wherever surface ground is required, private instead of public property should be used, if practicable

4. That the first lines of railway to be constructed should be on or near the important thoroughfares, coincident—or as nearly so as possible—with the main arteries of travel.

Resolved, That, as meeting these requirements in the manner most feasible for the west side of the city, this board hereby approves of a plan for an underground four-track railway under Broadway, from a point at or near South Ferry to Fifty-ninth St., thence under the Boulevard to a point at or near 169th St. (with such length of viaduct at and near Manhattan St. as may be necessary); thence under Eleventh Ave., or under private property immediately to the west thereof, as may be found most convenient, to such point as the contour of the ground may determine; thence by a viaduct across Spuyten Duyvil Creek, and by tunnel or viaduct to the city limits.

Resolved, That the general plan of construction from, at, or near South Ferry to near Forty-second St. shall be either by double-decked tunnel, with two tracks upon each deck or four tracks on the same level, as may be found upon examination and survey most expedient, the whole to be at such depth below the curb line as not to disturb the surface or endanger building foundations; from near Forty second St. north to be four parallel tracks upon the same level, as near the surface of the street as practicable when in tunnel, but not in open cut at any point.

Resolved, That the stations for such line of railway shall be upon property acquired for the purpose, and shall be provided with ample elevator capacity wherever the platforms shall be 20 feet or more below the curb line.

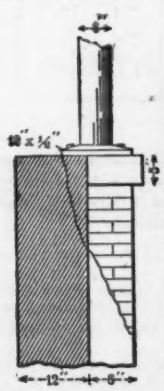
Resolved, That the motive power for such railway shall be electricity or some other power not requiring combustion within the tunnel.

Resolved, That the engineers of this board be and are hereby instructed to make the necessary surveys and prepare in detail the plans and specifications for such railway, and submit the same promply to this board for its further action in finally determining a general plan for submission to the Common Council, in accordance with the provisions of the Rapid Transit act of Jan. 31, 1891.

The total length of this proposed line will be about 18 miles. The section above Fifty-ninth St. is estimated to cost $1,000,000 per mile, while the section from Fifty-ninth St. to the Battery will average $3,000,000 per mile, making the total cost about $28,000,000. The Commission will now investigate routes for an east side line; and the engineering staff, headed by WM. E. WORTHEN, Past President Am. Soc. C. E., will make surveys, and prepare plans and specifications for the west side line adopted as above.

A Lesson in Supporting Iron Columns on Masonry.

Messrs. P. ALEX. PETERSON and THOS. C. KEEFER have made a report concerning the accident at the new building for the Young Men's Christian Association at Montreal, P. Q., which occurred on March 23. The building was under construction and was nearly ready for the plastering. In the center of the building on the ground floor there is a large hall, and all the floors and partitions above are carried by iron columns in this hall, which are supported by brick piers. The accident was due to the failure of one of these piers, which caused the fall of all the floors above and did damage amounting to about $5,000. A section of the pier which failed is shown in *Architecture and Building*, which gives also the following criticism of the work:



SECTION
Failure of a Brick Pier.

The pier that collapsed was an engaged pier. Instead of the wall and pier being a homogeneous mass, the pier was not properly bonded into the wall, but was more of a facing; the capstone, instead of being at least 12 ins. thick, was only about 5 ins., and not large enough to properly cover the pier. The result was that the iron plate, which it seems was also defective, cracked with the weight and crushed off the pier as indicated in sketch. It is easy to see that the cause of the trouble was, first of all, on account of the capstone, which was too small in every way to be of any use; secondly, that the column was placed very much on one side of the pier instead of in the center, and, lastly, on account of the defective construction of the pier.

Messrs. PETERSON and KEEFER criticise also the composition of the mortar, which, according to specification, was of one part Portland cement, two parts of lime and six parts of sand; and they say that one part Portland cement to two parts clean, sharp river sand would have been good practice for parts of the work below the ground level. Mortar made of common lime, however, is that used in general practice. Several other piers show defects besides the one that failed. Rebuilding them with cement mortar and replacing the coping stones with stones of ample thickness to evenly distribute the load are among the recommendations.

The Practical Aspects of Electric Welding.

At the annual meeting of the American Institute of Electrical Engineers in New York, May 20, a paper on the above topic was read by Mr. FREDERIC A. C. PERRINE, of Trenton, N. J. In the first part of the paper he describe some of the uses to which the electric welding process has been put, showing that its use at present was chiefly in processes to which the old method of hand-welding was inapplicable. We reprint the following extracts:

The first machine actually sold by the welding company was bought by the Roeblings. The pressure was applied by a handle regulated by the workman, the projection also being regulated by a scale stamped on the cam of the handle. Though considered crude, this machine did satisfactory work, often for 24 hours a day, and 6 days in the week, for about 2 years, and made about 370,000 splices in telegraph wire during its useful life.

After the automatic machines were brought to a reasonable perfection, we purchased a generator capable of welding up to ½ in. copper (40,000 watts), and installed one large transformer, and seven smaller ones, of capacity from No. 4 B. & S. copper to No. 18 B. & S. These have been at the works something less than one year, and show a daily record of over 1,000 welds in copper and iron wire.

Iron wire for the telegraph companies has to be delivered in bundles exactly ½ mile in length. Formerly these bundles were coiled from the completed wire, the lengths being spliced in the ordinary manner. Now all joints are made by electric welding, and the burr is removed by emery wheels so perfectly that it is nearly impossible to find the joint. Thus one handling of nearly the whole output of the works has been saved, and at the same time one of the greatest sources of difficulty, in joints electrically or mechanically defective, has been removed. Joints in copper wire for cables were formerly made by carefully scarfing the ends and joints with silver solder, a slow and expensive process. They are now made by electric welding.

Since last November three boys on three electric welding machines have made respectively in this work 10,570 welds, 7,642 welds, and 20,421 welds, the registers having been taken on April 16. Every weld is tested by bending and straining; and if one shows any weakness, it is quickly cut out and made again, with the loss only of a very small amount of time and the royalty to the welding company. In all of our welding of sizes below ¼ in. the ends are prepared by cutting square across with a pair of pliers, and then setting the cuts at right angles to each other, touching only at the center, from which the heat radiates to the surface. Then, after completion of the weld, the burr is removed by an emery wheel from the iron wire, and by a file from the copper The preparation and finishing is a little more complex in the larger sizes. The ends are filed to a true butt and chamfered at the edges, and after a reheating in separate clamps the burr of the weld is forged to the diameter of the original rod. The necessity of this will be apparent later on.

Messrs. Seward & Son, of New Haven, Conn., have at work a machine of somewhat universal character, its employment being principally in uniting Norway iron to Swedish steel in such shapes as are required in carriage irons and fifth wheels. In this work the burr is removed by a drop hammer at the same heat by which the weld has been made.

The crescent tires of the hundreds of bicycles manufactured by the Pope Manufacturing Company are welded and afterward formed by dies at the same heat. The material is soft steel. These people also have a machine for brazing small parts of their machines.

Besides using the electric welding machine for their telegraph wire, the Trenton Iron Company, of Trenton, N. J., have boldly attempted to make a weld in a wire rope to avoid the tedious, and, with their locked wire rope, impossible operation of splicing. The ordinary joint in a wire rope is from ten to twenty feet in length, and requires considerable skill on the part of the splicer and his assistants. The operation is to retwist bunches of wire from opposite strands, and to tuck the loose ends under the adjacent complete strands, which then hold them in place. With the locked wire rope, which is itself but a single strand, the only successful method of joining opposite ends has been to fasten securely around each a cast-iron collar, and after abutting the ends in a welding machine, to cement the whole together. The cast-iron collar is afterward broken off, leaving the rope as a solid bar for about 2 ins. at the weld.

Among the new solutions of old problems accomplished by the electric welding process, is that of the manufacture of spinning rings, by the Hopedale Machine Company, of Hopedale, Mass The old method was to stamp the ring from a sheet of metal and finish in a lathe, involving the loss of a considerable proportion of the original sheet. With a welding machine it is possible to form these little rings, about 2¼ ins. diameter, from a piece of bar iron, reducing the burr by a series of dies, with the result of a decreased cost and an equally satisfactory product.

One of the largest and most complete plants at present in operation is that of the Studebaker Bros. Manufacturing Co., of South Bend, Ind. They have at present nine machines, one of them for steel axles up to 1½ ins. square. After the weld is made it is quickly removed to a drop-hammer making about 300 blows per minute. At the same heat the axle is set ready for the market. The test for these axles is to bend to 90° while hot, and then back to alinement. No instance has yet been reported of an axle breaking under this test, which is frequently made to insure perfect workmanship.

They have also two machines for welding large tires up to about 4 ins. wide and ¾ in. thick. The weld is made in the usual way, and the piece is quickly taken to a hammer, where, by vertical and side blows, the burr is removed. One hammer will easily take care of two welders in constant operation. They have another machine for small carriage tires, 1 in. × ¼ in. and smaller. In this case the burr is removed by one blow of the hammer, after which the tire is set cold by a machine they call a cold stover, which embraces the tire on all sides, and by great compression sets it up to the felloe more quickly and as effectually as can be done by shrinking in the old method; this, of course, is an immense strain on the weld, being a compression beyond the elastic limit of the metal. They have two machines for making hub bands, and they are able to turn out about 1,200 on each machine. Besides these there are two or three machines for smaller miscellaneous work. All of the metal used by them is either iron or low grade steel. After the introduction of their plant, their machines made 360,000 welds inside of six months.

Probably the heaviest work done at present in electric welding is that of the Johnson Rail Co., of Johnstown, Pa. They are not, as has been stated in some journals, welding long lengths of rails together, since they already roll a rail too long to ship; but they do find economy in the process in some details of their smaller manufactures. As to their results in general they say:

"We would state that over a year ago we put in one welder for general work. The bulk of the work done on this machine was work we had totally failed to do by hand welding, not on account of the difficulty of the weld, but on account of the general unreliability of the result. The result of a year's use of the electric welder was that we have not known one of the welds made by the method to fail, and we have closed contracts with the welding company for four 40,000-watt machines and two 80,000-watt machines, with the intention of adopting the method extensively in our works."

Agricultural machinery has generally been furnished with iron wheels, consisting of a malleable iron hub into which the spokes are upset, and of a rim into which they are upset at the opposite end. The electro-welding machine has given us two new wheels, each of which are supposed to be preferable to the one described. In the first, manufactured by the Electric Wheel Company, of Quincy, Ill., the hub is cast of malleable iron, with spokes about 3 ins. long. To these are welded, by one machine, wrought-iron spokes, and, again, by another machine, these spokes are upset into the rim, which is itself welded into a tire, the product being a wheel of which the spokes are less liable to rattle loose at the hub. The second method is that of Niles & Scott, La Porte, Ind. The hub in this case is composed of two drop forgings of low-grade steel, grooved to receive the spokes; one-half is placed on the base of the welder and the spokes laid in their grooves, then the other half of the hub is put on and the clamp brought down. The current is then applied, and the whole, spokes and hub, welded solidly.

The Rogers Typographic Company, Cleveland, Ohio, are practically welding brass to steel, making as high as 800 welds per day, and thus effecting a great saving in the manufacture of their type-setting and founding machines.

The hardest steel at present worked by this process is that used for band saws, which is successfully welded by the E. C. Atkins Co., of Indianapolis, Ind Besides the regular work of making the joint in continuous band saws, these people have ingeniously adopted this method for replacing broken teeth in finished saws. Formerly they were compelled to cut down to a smaller size any saws from which one or two teeth had been accidentally broken, thus losing not only the difference in price between the two saws, but also the entire cost of labor in cutting the original saw. At present when a tooth is broken out they fit in a new tooth, which is electrically welded in place, and a drop of oil applied at the completing of the heat restores the temper to a serviceable point.

Pipe welding, which we all saw successfully accomplished at the factory last year, is put in practice by the Pennsylvania Railroad Co., as well as by the Columbus Iron Works, Columbus, O.; Blymyer Ice Machine Co., Cincinnati, O., and the Electric Pipe Bending Co., of Newark, N. J. This latter company is engaged principally in manufacturing long continuous coils for ice machines, blast-furnace tuyeres and radiators. With this machinery they not only weld extra heavy black pipe, but also electrically heat the pipe with a machine 20 ins. between the clamps for the purpose of bending to desired shapes over pipe formers.

With continuous spiral coils of pipe it has been necessary for a smith to weld the whole length, 150 to 200 ft., before attempting to bend any portion of it, and then after once the bending operation has commenced, in order to get a uniform spiral, the heat is not altered or the bending operation suspended till the coil is complete. Under the present electrical methods the coils are continuously heated in a fire, and the coiling is continuous, while one length of pipe is welded at a time. The welding machine is attached to the end of the moving pipe, and while the forward portion is undergoing the process of bending, a new length is welded on, which is accomplished in a sufficiently short time not to interfere with the coiling apparatus. In all of this pipe welding the burr is beaten down by means of a pneumatic hammer, which is put in rapid motion by the act of closing it around the pipe, a rapid hammer having proved much more effectual than any press or dies. This is probably on account of the more rapid cooling action of the press, since no forming is attempted before the weld is completed and the current is turned off.

Among applications of the process to ordnance manufacture are its use for welding the lengths of wire used in making the wire-wound guns, welding chrome steel points to tool steel bodies in making armor piercing projectiles, and for making chain cables. A machine is about completed for the Charleston Navy Yard which will weld chains with links up to 2 ins. diameter. The tests of the electrically welded projectiles have shown such good results that a contract has been made for a large number.

The author then reviewed the limitations of the electric welding process and the necessary precautions to be observed in its use substantially as follows:

Welding on an anvil by the aid of a forge is essentially the uniting of two surfaces of a metal which has previously been rendered plastic and which, under the hammer, can be made to intermingle into a structure similar or identical to the original metal; in consequence, this can only be accomplished with materials capable of passing into a plastic state before actual melting takes place. Thus it has long been possible to weld amorphous iron under moderate heat; but, a pressure high enough for the highly crystalline steels and other metals, has not been available in ordinary practice.

Welding cold has been accomplished in a most striking manner by Prof. SPRING, of Liège. Using small cylinders filled with powders of highly crystalline metals, he has not only succeeded in compressing them into compact bars, but has also succeeded in making alloys with all the characteristics of the same alloys produced in the usual manner in a crucible. These results go very far towards proving the absolute possibility of a weld in any material however fibrous or crystalline.

The electric welding process uses rather the method of the crucible than of the press; for although considerable pressures are applied during the operation, they are not beyond the limits of ordinary forging, and the essential difference is the greater heat available at the direct point where it is most needed, a heat which approaches and often reaches the melting point of the material. As the pressure is applied, it is transmitted by the cold bar directly upon the softened metal and forces it to unite more readily.

This view of the process brings us at once to some of the most important limitations: cast-iron, cast-steel, cast-copper, cast-brass, are not changed in their essential constitution, but are united by a weld having all the characteristics of the original bar. Now let us take a bar of rolled zinc or drawn copper and compare its structure with that of the cast metal. We find the crystals, formerly large and widely separated (especially in the case of zinc, where often internal oxide stains are perceptible), now are broken into minute fragments, elongated and united so closely as to allow the greatest opportunity for the action of cohesion. Weld such a metal as this, and the joint where broken will immediately show a rearrangement of the particles into larger and looser crystals similar to those of the unworked metal. By repeated fracture of the bar you will be able to follow graduations of the action till it loses itself.

A weld of this character will give a sufficient tensile strength, but the brittleness of a coarsely crystalline material has returned. Whether such a joint is worthless is entirely a matter of circumstances. With small sections the action is not perceptible on account of the very small length heated, and also because bending, however short, does not subject the metal to so great a strain as in the case with larger sections. For a rod to be subjected to further drawing, rolling, or other like process of manufacture, the weld is satisfactory, since the subsequent working reinstates the metal to its best condition, but for a wire to be considered a finished product, further manipulation is necessary.

In view of this, the later machines for welding heavy copper have been provided with reheating clamps and light rapid hammers, by means of which the burr, after a slight trimming, can be reheated and forged; in special cases a further hammering cold is added. Though this produces a great improvement in the metal, it yet leaves a good deal to be desired where great strength and pli-

bility are required. To produce this, a further upsetting of the metal throughout the whole heated space and a subsequent forging will be necessary. This, up to the present time, has not been provided for, and presents a greater difficulty than is at first apparent, besides furnishing a new proof of the crystalline constitution of copper. On account of this characteristic, as is apparent on attempting upsetting in the welding machine, it offers, at a red heat capable of moving and re-arranging the particles a resistance so high to compression that three or four times the pressure necessary for welding will not have the slightest effect toward increasing the diameter or upsetting. With bronzes the further difficulty is encountered of red shortness between the molten temperature of the weld and the malleable red temperature.

That this should offer so many difficulties may seem strange, since the metal does not apparently exceed the temperature of ordinary annealing; and it must be that either the passage of the current by an extra disturbance helps to rearrange the particles, or else the temperature is greater than we imagine from an observation. The latter explanation seems to me to be the more likely, since our ordinary observations are made on metals heated from an external source, and of which the surface is at the highest temperature. With the weld, however, the source of heat is internal, and the surface is undergoing a continual cooling from the external air.

Welds made in the higher carbon steels are at a similar disadvantage, and must be looked upon with disfavor unless provision for upsetting and forging hot is provided. Those disadvantages are especially apparent with steel wires of the highest grade, where the strength of the original material has been more than doubled by tempering and drawing. In such cases it is not ordinarily the oss of tensile strength that is to be feared, but the increased liability to snap under repeated bendings. This is especially important in the case of wire to be twisted into a running rope such as is used on our cable railroads. From this view, the weld in a whole rope where forging is impossible, would be necessarily defective, and though for a standing rope I have no doubt it would be fairly successful, yet for a running rope I believe everything tends to prove it dangerous. It has been suggested as an explanation that these effects are due to the presence of oxygen at the weld, producing suboxide in copper and reducing the carbon in steel. In support of this view the case of the application of oil to the hard saw teeth is cited as supplying the necessary carbon by its decomposition. It is undoubtedly a fact that by the heating of these high-grade steels, and subsequent slow cooling, some of the combined carbon is changed to the graphitic form, with a consequent loss of strength, and it seems clear to me that a drop of oil at the right moment serves to restore this,or, in other words, effects a tempering. It is almost useless to attempt an explanation by a complicated chemical decomposition, when the simpler molecular rearrangement is more in accordance with the facts and a more complete explanation.

This brings us to a point where the electric welding process throws light upon the actual production and nature of burnt steel. By increasing the heat in welding, no matter if rapidly, this effect can be produced as thoroughly as by the means of a fire; while if the name "burnt" were an accurate description, and the iron and carbon were oxidized, a sufficient time would be necessary for its penetration into the center of a bar of metal. This agrees with and is a further confirmation of the most modern ideas about burnt metal, that it is a molecular rearrangement, and that by careful forging and heating the metal can be restored to its original state. In this case oxidation certainly does not take place, though the action may be similar to metamorphism in rocks; steel being at the present day looked upon as a mineral, a matrix of iron including minerals which are generally compounds of iron with carbon, silicon, sulphur, manganese or phosphorus. Under this view there may be internal chemical rearrangement at high temperature. With carbon we know this to be the case, but I take it as settled by electrical heating that the change is not necessarily an oxidation.

The welding of two different materials, such as iron and steel or malleable cast iron, presents another difficulty and possible danger. When such a weld is broken we find that the pressure in the plastic state has forced the iron over the steel or malleable, which has itself been merely slightly melted and cemented to the adjacent particles of the iron. This produces what might be called a reverse riveting, the hot iron having been upset over the steel and inclosing it tightly, in the place of having been upset in a hole, as in ordinary riveting. Again, as in all this work, the tensile test is but a poor test of quality, and though a weld may have within 10 or 20% the tensile strength of one of the original materials, it is a fallacy to say that therefore the weld is within 10 or 20% of the quality of either of them. Use here again determines the serviceableness of the process.

STEEL TIES are not to be used near the sea or over salt soil on the Indian State Railways hereafter. It has been found that they corrode very rapidly in these places.

PERSONALS.

Mr. J. K. WILKES has been elected City Engineer of Danbury, Conn.

Mr. C. G. FORCE has been appointed Chief Engineer of the Department of Public Works, Cleveland, O.

Mr. JAMES BAKER, Master Mechanic of the Mount Clare shops of the Baltimore & Ohio R. R., died recently.

Mr. R. H. SOULE has been appointed Superintendent of Motive Power of the Norfolk & Western R. R., at Roanoke, Va.

Col. E. C. SMITH, St. Albans, Vt., Second Vice-President of the Central Vermont R. R., has been appointed General Manager, vice Mr. J. W. HOBART, resigned.

Mr. A. W. JACOBI, M. Am. Soc. C. E., has opened an office at 136 Liberty St., New York, as a Mechanical Consulting Engineer. Power plants, factory equipment and all kinds of machinery are his specialties.

Mr. FRANK KING, of Cincinnati, O., has been appointed County Engineer for Hamilton County, with office at Cincinnati, vice Mr. JAMES HARPER. Mr. KING has been First Assistant under Mr. HARPER for some years.

Mr. W. A. STONE has been appointed Master Mechanic of the Alabama Division of the East Tennessee, Virginia & Georgia Ry., and Mobile & Birmingham Ry., at Birmingham, Ala. He succeeds Mr. C. L. PETRIKIN, who has resigned to become president of a manufacturing business.

Mr. MELLVILLE E. STONE, Vice-President of the State National Bank of Chicago, has been appointed Chief of the department of foreign affairs of the World's Columbian Exposition. The London office of the Exposition will be in charge of Mr. R. S. MCCORMICK, Secretary of Legation for England.

Mr. DAVID BROOKS, electrician, died at Philadelphia, Pa., this week. Since 1845 he had been employed in the construction of telegraph lines, and was engaged in conjunction with JAMES D. REID in putting into operation the first commercial line in America. After the Baltimore and Washington line had been established by Mr. BROOKS, he extended it from Lancaster to Harrisburg, and a year later he constructed the line of the Atlantic & Ohio Co. between Philadelphia and Pittsburg. In 1851 Mr. BROOKS went to Mexico, and there built the first telegraph line in that country, between Vera Cruz and the city of Mexico. Upon his return in the following year he was employed by the Pennsylvania R. R. to manage its Philadelphia and Pittsburg lines, and in 1854 was made Superintendent and Manager of the Atlantic & Ohio Telegraph Co. This company was in 1862 absorbed by the Western Union, and then he was appointed District Superintendent at Philadelphia, holding that position for five years, when he resigned and devoted himself to the development of his inventions.

NEW PUBLICATIONS.

June Magazines—An article from the pen of Secretary TRACY describing "Our New War Ships" is the feature of this number of *The North American Review*. A very good summary of the progress made in the past 15 years in building an American navy is given; but the article is chiefly a reply to recent criticism of some of our new vessels in the London *Times*. That journal claimed that the estimated speed, coal endurance, and horse power of some of the American vessels now under way was based on a smaller amount of boiler-heating surface than was customary in British practice. Secretary TRACY spikes this gun by showing that the ratio of boiler-heating surface to indicated horse-power being over one-third greater in American vessels. The actual average ratio in a large number of the latest English vessels is 1.620 sq. ft. of heating surface per horse power. The average for 12 of the new American ships is 2,155.

In *The Forum* we notice that no less than three articles, "The New Northwest," by Senator DOLPH, of Oregon; "Our Chance for Commercial Supremacy" and "Southern Financial Interests," make extended references to the Nicaragua Canal. In each case it is spoken of as an enterprise of enormous financial and commercial importance to the whole country at large as well as to the special sections most interested.

In *Harper's* THEODORE CHILD continues his account of South American travel, describing a voyage up the River Parana from Buenos Ayres to Asuncion. Engineers who contemplate seeking their fortune in South America should be interested in this series of articles, which give a not very roseate picture of life in Spanish American countries. An article which all interested in municipal engineering will read with much interest is that on "Town and Village Government." The author places a high value on the New England town meeting as a means of educating citizens in the responsible work of self-government.

The Popular Science Monthly contains an article on "The Manufacture of Wool," one of a series on the development of American industries since Columbus. The author, however, has taken up so much space in describing the anti-Columbian period of the industry with its general nature that he does scant justice to the period covered by the title, and devotes hardly two pages to the modern processes of spinning and weaving with power-driven machinery, which is of greater interest to the engineer, at least, than all the previous history of the art. An article entitled "Our Grandfathers Died too Young" shows that a very large share of the increase of human longevity is due to the achievements of engineers and inventors in revolutionizing and perfecting the art of modern sanitation. We may note also a well-engraved portrait of Nicolaus Copernicus inserted as a frontispiece to this number.

The Slide Rule. By WM. COX. New York, 1891, Keuffel & Esser Co. 8vo, pp. 30, 60 cts.

This is a reprint, considerably expanded and with much matter added, of some articles which Mr. COX has contributed this journal, and which, we need hardly say, are regarded as excellent. It constitutes a useful manual of the slide rule, and for practical use the best one extant.

Artistic Homes in Country and City, with Other Examples of Domestic Architecture, By ALBERT W. FULLER and WM. ARTHUR WHEELER. Architects, 5th and revised edition. Boston, Ticknor & Co. Oblong. 4to, pp. 70, heliotype plates. $6.

The reviewer expects a considerable task on taking up this bulky volume, but is agreeably surprised to find that it consists within, not even of a "rivulet of text," but of plates only, these being preceded by a brief "introductory note" only. The plates are divided into approximately equal thirds of extensions, interiors, and floor plans, and show some fine effects, especially in the interiors, but as they are confined to the works of a single firm of architects they do not call for critical notice.

—Who Owns the Lake Beds? F. HODGMAN, Battle Creek, Mich., 1891. Review & Herald Pub. Co. Pamph. pp. 6.

This is a reprint of a paper read before the Michigan Engineering Society in January last. After discussing various judicial decisions, the author concludes: (1.) That the beds of non-meandered lakes belong to the owners of the adjoining land, and the boundaries are found the same as if no lake were there. (2.) That the beds of navigable lakes belong to the State. (3.) That the beds of meandered non-navigable lakes belong to the general government.

—Water-Works Reports.—The following annual reports have been received, the gentlemen named being superintendents unless otherwise specified: Manchester, N. H., C. K. WALKER; Attleborough, Mass., H. A. BODMAN; Clinton, Mass., H. H. LOWE; Needham, Mass., J. M. HODGE; Little Falls, N. Y., S. E. BABCOCK; Woodbury, N. J., B. W. CLOUD; Harrisburg, Pa., C. D. STUCKER, Secretary; Lynchburg, Va., J. B. PAGE; Savannah, Ga., JAMES MANNING; Toledo, O., D. SEGUR, Secretary.

—Annual Report of the Lowell Water Board and Reports of Superintendent of Water Works and City Engineer. C. L. KNAPP, Secretary; G. E. EVANS, City Engineer. Pamph.; pp. 102, frontispiece and folding sheet of tables.

In addition to the usual matter this report contains a discussion of rates, with extended references to and quotations from the "Family and Meter Water Rates," given in the 1889-90 MANUAL OF AMERICAN WATER-WORKS. As was stated in the Introduction to the MANUAL, the rates of thirty-three cities given in the 1889 report of the Lowell Water Board afforded suggestions in compiling the extended tables in the MANUAL. The subject is an important one and worthy of the consideration given it by the Lowell Board. The report describes the new Worthington 10,000,000-gall. engine, a cut of which is given. Filtration is also discussed in the report, the present filter gallery described, and shown in plan by a cut. In this connection both ENGINEERING NEWS and the MANUAL OF AMERICAN WATER WORKS are quite extensively quoted. The statistical matter in the report is, as usual, very full and valuable. We understand that the report can be had by applying for the same. Those interested in water-works will do well to secure a copy.

—Annual Report of State Geologist of New Jersey for 1890. Board, 8vo, 305 pp. and two maps. Published by the State. Mr. JOHN C. SMOCK, State Geologist; Mr. IRVING S. UPSON, Asst. in charge of office, New Brunswick, N. J.

This publication is fully up to the high standard established under the wise rule of the late State Geologist, Dr. GEORGE H. COOK, who died Sept. 22, 1889. In addition to the names above given, the official survey staff is made up of Mr. FRANK L. NASON and Mr. C. W. CORNAN, Assistant Geologists, and Mr. C. C. VERMEULE, Cartographer. Mr. UPSON has charge of the distribution of reports and maps at the address given.

To many of our readers the most interesting portion of the present report will be found in the work of Mr. VERMEULE on the water-sheds of New Jersey, and a report upon the water supply and water-power of the state. And in this, as in its earlier publications of this nature, the State of New Jersey has set an example that cannot too soon be followed by all the other state governments.

The general result of the observation of stream-flow and rainfall is plotted upon a map of the state to a scale of 5 miles to the inch, showing the water-sheds for each stream. While the question of water supply for cities and towns has been treated of in the earliest reports of Dr. COOK, excepting in the northeastern part of the state, that of water-power is new in the history of the survey. The map here issued shows the sources and courses of the streams and their relations to towns and lines of transportation; but the gaging of these streams for the purpose of ascertaining their available water-power, is a work necessarily slow and still in progress. Of the value to the community of even approximately accurate data on this head no one can doubt.

In his report on water-supply and water-power, Mr. VERMEULE commences by a short sketch of the effort made by the State Survey to aid in the development of the natural sources of wealth in the state, including, of course, its valuable hydraulic resources. Fully appreciating the fact that a complete study of the stream-flow means careful and continuous gaging, and a study of evaporation and rainfall extended over a long period of years—a refinement far beyond the present purpose of the state and its means for carrying it out—the author has yet done most valuable work in this direction. The most has been made of the means at hand in collecting, sifting and arranging data already secured by others, and gages have been set up and readings taken on several streams. Continuous series of gagings have been obtained for the Paulinskill, Musconetcong, Ramapo, Passaic, Rahway, Raritan and Great Egg Harbor rivers for nearly one year, and on the Pequest for eight months, or enough to show its marked similarity to the Paulinskill. On the upper Rockaway a three months' series is on hand; four months on the Wanaque; six months on the Pequannock and others. On the Passaic a record had been kept since June, 1888, of the height of water on the stone dam of Messrs BEATTIE, at Little Falls. A full canvass of the water-powers of the state has been completed south to the southern limit of the Raritan water-shed; and this is also true for the Maurice and Great Egg Harbor and most of the Rancocas water sheds, in the southern part of the state.

In referring to the abandonment of water-power for driving the many iron forges of Morris County and the sawmills all over the state, Mr. VERMEULE points out that the power is not at fault. Blast furnaces have made iron forges unprofitable with any kind of power, and the destruction of forests in the neighborhood of sawmills have driven these out, or have made it necessary to set up steam mills among the timber and remote from streams. The single water-power plant of the Dundee Co., at Passaic, is equal to all the abandoned forge-powers; and the Warren Paper Co.'s 700 HP. plant, recently erected at Musconetcong, is equal to at least 30 of the abandoned sawmills. In other words, water-power is not being abandoned in New Jersey, but it is being more efficiently applied.

In outlining his proposed line of investigation Mr. VERMEULE gives the following general heads as those adopted: A study of streamflows; description of water-shed and ordinary and dry-season flows; deep and shallow well supplies; quality of waters; a review of existing water supply; water-powers of the state, and a compilation of court decisions affecting the ownership and use of rights in water in the state.

We cannot, in the space at our disposal, even give an abstract of the more detailed reports of Mr. VERMEULE upon the various streams already above named. This portion of the report alone covers over 120 closely-printed octavo pages, and its nature is such that it cannot be usefully condensed. In discussing the flow of streams, however, the author calls attention to the fact that while we have considerable data upon evaporation from water surfaces, we have very little on evaporation from the ground and the daily consumption of water by crops. Mr. TWEEDDALE, C. E. (Kansas State Board of Agriculture Report, Dec. 31, 1889), concludes, from Risler's tables of water consumption by crops, that from seed-time to harvest cereals will take up 15 ins. of water and grass 37 ins. of water. These figures agree with irrigation practice, and also explain the low summer flow of streams in a highly-cultivated water-shed. Mr. VERMEULE gives useful rules, at some length, for computing storage and growing periods, computing summer and autumn flows, replenishing periods and value of computed flows.

In referring to developed and undeveloped water-power and storage, the report gives a number of sites along the Delaware and Rockaway rivers, and concludes with a long list of water-powers in Northern New Jersey on the various rivers of that section.

The general report continues with special reports on artesian and other bored wells and the reclaiming of land by drainage. A large part of the report is also devoted to notes on active iron mines, by Mr. FRANK L. NASON, accompanied by maps showing these mines and other features connected with the iron industry.

TRADE PUBLICATIONS.

—*Price List of Engineering, Mining and Surveying Instruments.* Philadelphia, 1891: Young & Sons, 7 x 3 ins., 23 pp.

—*The Berlin Iron Bridge Company, of East Berlin, Conn.*—New catalogue of general iron construction. The many illustrations of actual work performed by this company, with a concise description of each one, are especially commendable for their artistic merit, and surpass in clearness and usefulness, from the engineer's standpoint, any illustrated trade publications of this character that has yet come to our hands. The list is a very long one, but is chiefly devoted to roofs, floors and iron building generally.

SOCIETY PROCEEDINGS.

International Association of Car Accountan's.—The sixteenth annual convention will be held at Denver June 16 and 17. A program will be sent on application to Mr. S. P. Sechrist, Secretary, 92 Pine St., New York.

New England Water-Works Association.—The New York, New Haven & Hartford R. R. Co. will sell round trip tickets to the annual convention at Hartford, June 10 to 13, at the rate of a fare and a third. The Boston & Albany, Fitchburg, New York & New England and Old Colony R. R. Co.'s will issue tickets on the certificate plan at the same rate. It has been previously announced by circular that a reduction in fare would not be given, but it has finally been secured. For further particulars address R. C. P. Coggeshall, Secretary, New Bedford, Mass. An outline of the program for the meeting was given in these columns last week.

Master Car Builders' Association.—The following are the committee reports to be presented at the annual convention to be held at Cape May, N. J., beginning at 10 A. M., June 9:

1. *Metal for Brake Shoes*—G. W. Rhodes, B. K. Verbryck, E. B. Wall.
2. *Lettering Freight Cars*—E. W. Grieves, G. W. Demarest, R. D. Wade.
3. *Steam Heating and Ventilation of Passenger Cars*—J. N. Barr, T. A. Bissell, J. W. Marden, J. C. Barber, W. H. Lewis.
4. *Steel Plate and Malleable Iron in Car Construction*—Wm. Forsyth, John Mackenzie, E. D. Bronner.
5. *Wheel Guarantee*—J. J. Hennessey, Thomas Sutherland.
6. *Joint Car Inspection*—A. M. Waitt, H. C. McCarthy, S. Irvin, H. Middleton, Wm. Garstang.
7. *Air Brake Standards, and Inspection and Care of Air Brakes on Freight Cars*—J. S. Lentz, Wm. Turreff, N. W. Sample.
8. *Report of Executive Committee on Plan for Maintenance of M. C. B Coupler Standards.*
9. *Report of Executive Committee on Journal Box, Bearing and Lid for 60,000-lb. Cars.*
10. *Report of the Arbitration Committee.*

Wednesday, June 10, will be devoted to the revision of the Rules of Interchange, unless otherwise ordered.

For the convenience of members of the Association the Pennsylvania R. R. will run a special train from Philadelphia to Cape May on Monday, June 8, leaving Camden about 8 P. M. JNO. W. CLOUD, Secretary.

Western Railway Club.—At the meeting on May 19 the first subject discussed was "Air Brakes in Interchange." Messrs. Wm. Forsyth, Rhodes and Grieves opposed the recommendation recently adopted by the Central Railway Club, that the owner of a car equipped with air brakes should be responsible for repairs to the brake equipment made on a foreign road, when said repairs were made necessary by damage done on foreign roads. It was finally recommended that a code of rules for the interchange of air-brake cars should be adopted, providing for the refusal of cars with air brakes not in good working order, and specifying what should be considered "good working order." The stenciling on brake cylinders and auxiliary reservoirs for showing dates of cleaning, oiling and testing, recommended by the Central Railway Club, was approved. A paper on "Steam Heating of Trains," by Prof. W. S. Johnson, of Milwaukee, was read and discussed; an abstract will be found elsewhere.

A short discussion on the working of steel then took place. Mr. Barr called attention to the samples of steel recently sent out by the Shoenberger Steel Co. to illustrate the serious injury done to steel by working it at a blue heat. He intended to enforce a rigid regulation in the Chicago, Milwaukee & St. Paul shops, that a steel plate shall never be worked unless either cold or red hot.

Mr. Gibbs spoke of the increase in tensile strength and decrease in elongation in fire-box sheets after long service through the absorption of carbon. He had recently tested a cracked fire-box sheet which showed an increase in tensile strength of 3,000 lbs. and a reduction in elongation of 8%. The contrast was as follows:

	Original.	After removal.
Tensile strength, lbs.	53,000	56,000
Elongation, per cent.	30	22

The analysis showed that the carbon had undoubtedly increased, although hardly enough to account for the change in physical behavior. Mr. Rhodes said that this showed why the railways were generally particular to have low tensile strength and sufficient elongation in new plate to permit with safety the usual hardening in service.

The subject of joint inspection was then brought up; and it was stated that the general offices of the roads centering at Chicago had asked the heads of the car departments to again try and formulate some plan. It was finally voted that a meeting of the members interested should be held at the Cape May convention immediately after the report of the joint inspection committee of the Master Car Builders' Association.

American Society of Civil Engineers.—The regular monthly meeting was held June 3, Vice-President A. Fteley in the chair.

A short paper on "A Cheap Covered Reservoir," by Mr. A. D. Foote, was read by the Secretary. The reservoir is at Boise City, Idaho, the domestic cold water supply of which is taken from shallow artesian wells on the flank of a mountain above the city, which overflow at about 175 ft. above the city and supply about 1,000,000 galls. per day. A chamber has been excavated in the soft sandstone rock, 125 ft. long, 20 ft. wide and 7 ft. high. The inside is plastered with a cement mortar of 3 sand to 1 Portland cement. To support the roof a row of brick pillars has been built through the middle, 8 ft. c. to c., and each pier 20 ins. square. The following papers were also read: "Neat Tests vs. Sand Tests for Portland Cement," by Mr. S. Bent Russell, and "Notes on Cement, Mortars and Concretes," by Mr. W. U. Grant.

In the discussion Mr. J. F. Crowell referred to the value of the latter paper in pointing out the difficulties encountered in practical work and with ordinary workmen. The proper mixture of mortar is very important, but difficult to obtain, and tests of the mortar should be made. He considered sand tests to be necessary. Mr. C. B. Brush thought a good deal depended upon the engineer. If he is strict in requiring all cement to come up to the specified standard and in rejecting all other, he is pretty sure to obtain what he wants, while if it is thought he will give way under threat of stopping work, etc., a lower grade is liable to be furnished. Neat and sand tests are both required. Short-time tests should be used to decide the acceptance of the cement, and the long-time tests also carried out as a check. Mr. Fteley stated that to eliminate free lime from cement by aeration the cement for the Vyrnwy dam of the Liverpool (England) water supply was spread upon 7 galleries in a house built for the purpose, each gallery having a capacity of one day's supply and having a floor of slats that could be turned by a lever. Each day the supply was taken from the bottom gallery, the cement on the second gallery dumped into the first, and so on, a fresh supply being then placed on the top gallery. In this way the cement was given a thorough aeration for 7 days.

The following candidates were declared elected:

Members: Bernard F. Booker, Assistant Engineer, A. T. & S. F. R. R., Topeka, Kan.; Thomas M. Jackson, West Virginia State University, Morgantown, W. Va.; John H. Morton, D. & R. G. R. R., Denver, Col.; Geo. W. Vaughn, Consulting Engineer, A. T. & S. F. R. R., Leavenworth, Kan. *Associate Members:* John F. Healy, Assistant Engineer, Alabama Great Southern Ry., Birmingham, Ala.; D. E. Moran, with Scoysmith & Co., New York, N. Y.; Thomas K. Thomson, Engineer of Bridges, Norfolk & Western R. R., Kenova, W. Va.; Albert L. Webster, New York, N. Y.; James K. Wilkes, Assistant Engineer of Sewers, New Rochelle, N. Y.

The Annual Convention of the American Society of Civil Engineers.

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On May 23 the business meeting of the convention was held, and the first business was the report of the committee appointed on the first day of the convention to report on the best method of appointing the Nominating Committee for offices for 1892. Under the new constitution each convention must decide for itself how to appoint this nominating committee. The committee recommended the division of the membership into seven geographical districts, giving an approximately equal number of members in each, the members present from each district to present three names, one of whom shall be elected by a ballot of all the members present, the president to select names for any district for which no names are presented. The suggested plan gave rise to considerable discussion, it being claimed, on the one hand that it was complicated, that a packed ticket could be arranged as easily as by the old plan, and that the districts should elect their own representatives; while, on the other hand, it was claimed that the society at large had as much interest in the election of the members of the nominating committee as the separate districts have. Mr. NORTH moved an amendment that each district should nominate a member, the nomination being equivalent to election, but the amendment was lost. Mr. SKINNER stated that the idea of the proposed plan was that the districts should provide the candidates and the society in convention has its choice from these candidates. Mr. FRANCIS thought that the committee had given the

matter careful thought, and that therefore their plan should be tried, as it is not binding on other conventions. The report was adopted.

The members then assembled by districts and nominated three candidates each, or 21 in all. These names, with their districts, were then written on the blackboard and blank ballots passed round, on which each corporate member wrote one name for each district The seven districts and the names of the elected members of the nominating committee (the name being in each case the first of the three presented) were as follows:

No. 1.—New York City and 50 miles around; 265 members. Mr. P. F. BRENDLINGER.

No. 2.—New York, New Jersey, Delaware, Canada and foreign; 154 members. Mr. GEO. S. FIELD.

No. 3.—Maine, Vermont, New Hampshire, Connecticut, Massachusetts and Rhode Island; 131 members. Mr. HENRY MANLEY.

No. 4.—Pennsylvania, Maryland and District of Columbia; 162 members. Mr. WM. METCALF.

No. 5.—Ohio, Indiana, Illinois, Wisconsin and Michigan; 145 members. Mr. C. L. STROBEL.

No. 6.—Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota, South Dakota, Wyoming, Colorado, Idaho, Utah, Washington, Oregon, Nevada and California; 178 members. Mr. W. S. LINCOLN.

No. 7.—Virginia, West Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, Mississippi, Arkansas, Texas, New Mexico, Arizona and Indian Territory; 108 members. Mr. O. H. LANDRETH.

Mr. METCALF then presented a resolution in the line of his remarks during the above discussion, requiring the secretary to issue blank ballots before the next convention, members to fill in the names of proposed members of the nominating committee, and the ballots to be opened at the convention. This gave rise to an animated discussion as to the status of the Board of Direction, whether it has control of the society or is subject to instructions from the society. Mr. SHINN stated that the board is legally and morally responsible for the financial affairs of the society, and that therefore the proposed plan cannot be carried out unless the board authorizes the necessary expenditures. He did not think the convention legally competent to give instructions to the secretary of the society. Eventually the resolution was modified and adopted as follows:

"*Resolved*, That at least 50 days before the next annual convention the secretary shall issue, under the orders of the Board of Direction, a blank ballot indorsed 'Nominating Committee' to all members of the society by districts as adopted at this convention. Upon opening the ballots at the next convention that convention is requested to select from each district one of the names presented from that district, and it is recommended that the ballots be limited to the three names having the highest number of votes in each district."

Mr. SHINN then read the report of the committee on the proposed engineering convention at the Columbian Exposition. The object of the committee is to provide headquarters for engineers visiting the Exposition at Chicago in 1893, and to arrange for an international engineering congress. It was recommended that the local societies co-operating in the proposed arrangements should each elect one member of the joint committee; 2 members each by the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers and American Society of Electrical Engineers, and 3 members by the Western Society of Engineers. The report was adopted. The secretary then presented a subscription list for the monument to the late Capt. EADS.

Reports of standing committees were then presented. The Committee on Units of Measurement presented a progress report, Mr. EGLESTON writing that owing to his departure for Japan he had not had time to do any but preliminary work in the matter. The committee was continued. The Committee on Impurities of Water Supply also made a progress report and was continued. The Committee on Rail Sections reported progress. Mr. BOUSCAREN stated that no meeting of the committee had been held since the last convention, but that all the work done had been by correspondence. The committee was continued. The Committee on the Causes of Failure of the South Fork Dam presented its report, which has been ready for some time, but held back until matters before the courts in connection with damage cases had been concluded. The committee visited the site as soon as railway communication had been reopened, and made a very careful examination of the dam and a thorough investigation as to the causes of the failure. There were 2,250 persons known to have lost their lives, 1,675 bodies were recovered, of which 1,025 were identified. The loss of life probably did not exceed 2,500, while the loss and damage to property amounts to between $3,000,000 and $4,000,000. The report gave a full history of the dam since the surveys made by Mr WELSH in 1834, with the specifications and prices of the work done in 1839 under the Canal Commissioners, and included a detailed statement by Mr. PARKE, an engineer who was on the spot. The committee estimated that the dam was strong enough to resist the pressure of the water, but was washed by the overflow until it was so weakened as to give way. The failure was therefore mainly due to the insufficient capacity of the spillway, as if it had been large enough the water would not have flowed over the dam. The report was accepted, and the thanks of the society voted the committee for its work. In the discussion Mr BRENDLINGER stated that he had taken careful levels about a year ago, and in his opinion the crest of the dam was lower at the middle and thus let the water over sooner than if it had been level. He estimated that the fish screens took up 42% of the spillway. The new material which he saw put in during 1890 was not rolled, but simply thrown down like a railway bank. Mr. COLLINGWOOD stated that he had also taken levels, but as both his and Mr. BRENDLINGER'S were taken a year after the accident he thought the committee's levels, etc., should be taken as more reliable. He was convinced that there was no great depression in the middle, and there was evidence that the water did not begin to go over at the middle but at dozens of places all along the little ridge which had been thrown up by a plow, and that afterward it flowed over for a width of 200 or 300 ft., while men walked through it for half an hour. The water did not run over the ends of the dam at all. Col. MERRILL said he had been told that it ran over first at the middle to a depth of 18 ins. Mr. J. B. FRANCIS, one of the members of the committee, stated that the dam had been lowered about 2 ft. along the middle part in order to widen the roadway on top from 10 ft. to 15 or 20 ft., the ends rising to the original level. He did not think that taking the figures of the other gentlemen would alter the ultimate result of the investigation. Full particulars of the accident and of the construction of the dam have been given in ENGINEERING NEWS. After the presentation of this report the business meeting adjourned, and the regular meeting of the convention proceeded with.

A paper entitled "A Memoir on Water Meters" was read by the author, Mr. JOHN THOMSON. The paper referred to the early history of water meters, and the inventions patented since 1824 in England, and 1837 in the United States. Tables were given of the meters, taps, etc., by states and by cities, compiled from ENGINEERING NEWS "Manual of American Water-Works, 1889-90." There are but two general types of water meters: 1, the positive displacement type, the principle of which is the successive filling of a chamber and the displacing of the fluid therefrom by mechanism capable of being acted upon by pressure; 2, the inferential type, which infers the total quantity, not by measurement of bulk, but by lineal velocity or by pressure. The writer considered that for all practical purposes, in ordinary public service, a meter which will register to within 5 or 7% of accuracy between fair minimum and maximum rates of discharge, is amply accurate for the purpose. He did not think the meter of the future had yet been designed, but thought the rotary would supplant the reciprocating piston and the inferential meters. There was no discussion of this paper. An editorial note on this paper was given in our issue of May 30.

Mr. JOHN M. GOODWIN then made some remarks on "The Proposed Lake Erie & Ohio River Ship Canal," particulars of which canal, taken from a report made to the Pennsylvania legislature in February were given in ENGINEERING NEWS, March 21, 1891. The distance from Conneaut Harbor on Lake Erie, to the Beaver River will, be 103 miles, and there will be direct access to Pittsburg. The depth will be 15 ft. over lock sills. In regard to the commercial necessities for the canal, if the present growth of the steel and iron trade of Pennsylvania continues, more than twice the present amount of ore must be brought from the lake ports, which cannot be done by rail. The average ore cargo at Ashtabula is 1,500 gross tons, which is stored in the ship length of 215 ft., while on the railway it occupies 77 cars 33 ft. in length. The railways cannot get these long trains to the furnaces, as when the head of the train is at the furnace the other end is at a considerable distance. This is one of the reasons which limits the capacity of the railways, while all the lines running south from the lake have to climb grades of 60 ft. to the mile. The old canal was abandoned, as owing to quicksands the summit level had to be changed, with a 4 ft. lock at each end, and no water could be obtained. Water had to be pumped into the canal by a bucket wheel. This canal gave no access to Pittsburg. At the time the old canal was in operation coal trains consisted of 26 to 28 gondola cars, carrying 11 tons each. and Mr. GOODWIN stated that he had scale weights of 75,000 cars of the present type, showing that the average load is now less than 39,000 lbs. of ore. Mr. NORTH thought that there was too great a tendency among American engineers of water transportation projects to reduce the depth of the canals. and that the proposed depth of 14 ft. of navigation would not be sufficient for such a canal and traffic. A depth of 22 or 23 ft. would be better, and would reduce freight. The capacity of a ship varies with the cube of its depth. In reply, Mr. GOODWIN stated that the steamship Cambria, 280 ft. long, 40 ft. beam and 20 ft. depth of hold, has a capacity of 2,319 gross tons with a draft of 16 ft. 2 ins., and 1,800 tons with a draft of 12 ft. Vessels could earn more money by loading a foot less, burning less coal and running at lower speed. The rate for lake ore from Marquette to Cleveland and thence by rail to Pittsburg is $2.05 per ton, while by steamer all the way it could be carried for $1.25 per ton. He thought the government would carry out the work and make it a free canal. The meeting then adjourned.

The banquet was given in the evening, about 120 persons being present. Although the "grand march" did not begin until 8 P. M., instead of 7 P. M., according to programme, the arrangements were managed better than they have been on some previous occasions, and the affair concluded about midnight. The dinner was fairly good, but there was some expression of opinion to the effect that the prices for tickets, $6 for men and $4 for ladies, were higher than they should have been. The speeches were mostly brief and not particularly noteworthy, for engineers are not, as a rule, remarkable for rhetorical effects. The toasts were as follows: "The American Society of Civil Engineers," President OCTAVE CHANUTE; "Chattanooga, the Gateway of the New South," Gen WARNER; "The Engineering Press," H. G. PROUT; "The Military Engineer, in War and in Peace," Col. W. E. MERRILL; "Our Guests," Judge KEY; "Our Summers in the Mountains," CHAS. B. BRUSH; "Our Railways," GEO. B. NICHOLSON; "The Mission of the Engineer," WM METCALF; "Woman," Capt. R. W. HUNT. On the whole, a pleasant time was spent.

On May 25 the session commenced about 9.30 A. M., with a small attendance. A brief abstract of a paper by Mr. WARD BALDWIN on "Stresses in Railway Bridges or Curves," was presented by the Secretary, the paper being of too mathematical a character for reading. A resolution put by Mr. METCALF was carried, to the effect that the Board of Directors be requested to consider the practicability of setting aside the entrance fees from new members to pay off the debt on the society building. An excellent paper on "Sections and Mechanical Conditions of Car Wheels" was then read by Mr. P. H. GRIFFIN. He considered that in comparison with the attention being paid to track and rolling stock equipment, not enough attention is being paid to the proper design and construction of the wheels which carry the rolling stock upon the track. Of this paper we shall publish an abstract. Mr. GRIFFIN stated in answer to a question that the depth of chill is 5/8 in., so that in turning a wheel 1/4 in. can be taken off, reducing the diameter of the wheel 1 in. A paper by Mr. LATHAM ANDERSON on "The Single Trap System of House Drainage" was then presented. The author described the present system, the Murphy system, and proposed a single-trap system. This included the abolition of all local traps except grease traps to sinks, which are so arranged as not to be air traps; a single trap between the sewer and the house, with a metal flap valve just below it; a main up-take house vent, and no inlets for outer air. This would effectually exclude sewer gas. Fresh-air inlets near the ground are inadvisable, the air near the ground being impure. The overflow pipes of wash-basins are the foulest part of the drainage, and the plan proposed included vertical overflow pipes in the basins, which could be cleaned by brushes attached to wires. Mr. C. B. BRUSH thought the proposed plan open to serious objection. The dangerous gases do not come so much from the sewer, but are generated in the pipes, and he doubted the advisability and necessity of the trap at the entrance to the house. There should be complete and free circulation to the roof, as at present, with special pipes running up from and ventilating the traps. If basins are not used or a house is closed for a few weeks, water should be allowed to run through the pipes for some time. The criticism of ground inlets for fresh air he considered good. Mr. COLLINGWOOD referred to the advantages in point of cleanliness of the proposed arrangement of overflow pipes to basins. The next paper was "A Trip through the Big Horn Cañon," by W. E. GILLETTE, which was read by the Secretary. It was descriptive merely, after the style of a magazine article, and as further particulars of engineering interest are promised, including maps and estimates of cost of a railway through the cañon, the publication should be deferred until such information is furnished. The cañon is 50 miles long, in Montana and Wyoming. Almost at the commencement the sides rise vertically 500 ft., and the talus extending 25 to 100 ft. is washed away in places, the cliffs rising directly from the water. At one point the vertical walls were 600 ft. high, with a slope of 40° rising beyond for 200 ft., while in the Devil's cañon the walls were 1,000 ft. high. There is one good ford, and one trail leading out from the cañon on both sides. At the steepest rapid the width of water is 40 ft., the usual width being 200 to 300 ft. Mr. FRED BROOKS then presented a paper by Mr. DESMOND FITZGERALD on "The Yield of the Sudbury River Watershed in the Freshet of February 10 to 13, 1886." This freshet was caused by one of the most disastrous rain storms that has occurred in New England. About 8 ins. of rain fell over Rhode Island, which included the center of the storm. In Massachusetts it was less but a great deal of damage was done. The area in which over 8 ins. of rain fell was 750 sq. miles, 750 sq. miles between 7 and 8 ins., 1,500 sq. miles between 6 and 7 ins., 1,850 sq. miles between 5 and 6 ins., and 2,750 sq. miles between 4 and 5 ins., or 7,600 sq. miles with over 4 ins. of rainfall. The ground was frozen, and was covered with about 2 ins. of melted snow, The rain on this watershed was 4.64 in., or

a total of 6.64 ins. precipitation including the snow. The watershed is one of the sources of water supply of Boston; it is 25 miles west of the city, and has an area of about 75 sq. miles. About 38% of its surface is covered with woods. The maximum yield per 24 hours was equal to 1.54 ins. in depth upon its surface. The dams of the Boston water supply are proportioned for a continuous flow per day of 6 ins. in depth over these watersheds. Mr. FRANCIS remarked upon the importance of the paper, and the necessity of providing sufficient outlet for water from such storms. Mr. COLLINGWOOD stated that there ought to be more information on the questions of rainfall and flow of streams as matters of record of great value to the hydraulic engineer. The remaining papers were then read by title.

On motion of Mr. E. P. NORTH, a vote of thanks was tendered to the Chattanooga committee of arrangements for their attention to and entertainment of the society, to Mr. S WHINERY, M. Am. Soc. C. E., for his indefatigable work to promote the pleasure and convenience of the members, and to the other engineers and railway men for the courtesies extended. The convention then adjourned.

There was but one exhibit, that being the Goldie railway spike (ENGINEERING NEWS, Nov. 23, 1889), well made, nickel-plated specimens of which were distributed by Mr. GOLDIE, the inventor. This spike has sharp, clean edges and smooth surfaces, each reducing the tendency to crush and tear the fibers of the wood when being driven, and giving it a consequently better hold in the tie than the ordinary rough spike. Among the souvenirs distributed were an illustrated pamphlet on Chattanooga and its industries, and a handsomely bound book of the classes and courses of Cornell University.

The place selected for the convention, on the summit of Lookout Mountain, was an excellent one, being pleasantly located amid beautiful scenery and away from the distractions of a manufacturing city, while within easy reach were the city and manufactories of Chattanooga and many other points of engineering and general interest, including the electric railway, the broad-gage railway, which winds its way up the mountain with grades of 3%; the incline cable railway, with a grade of 33%, and the 3-ft. gage railway, which has some bold features of construction. The Lookout Inn is a new and large hotel with a capacity of about 650 persons, and is well situated and well managed. Ample accommodation was afforded the members and guests, and everything was done for the comfort and convenience of the party. The meetings were held in a very suitable and pleasant room, and they were well attended and well managed, the business being carried on with commendable promptness. The convention was a thoroughly pleasant and successful affair, and everybody appeared to be pleased and satisfied.

It is a singular fact that the daily papers of the South, with the exception of those of Chattanooga, paid no attention to reporting the proceedings of the convention. The proceedings of labor organizations and employees' associations are reported more or less fully by the daily press throughout the country, while those of such an important association as the American Society of Civil Engineers are practically ignored. This fact was commented upon by some of the members who are most interested in the welfare and growth of the Society, and it appeared to be the opinion that the standing of the Society and its close connection with matters of public interest are not yet generally understood as being those of a body which is of national importance.

Chattanooga is a city of growing importance and is a large railway center. It has a population of 50,000, including the suburbs, with taxable values of $15,000,000. There are 227 industrial establishments, representing a capital of about $10,275 000, employing nearly 8,000 workmen at a cost of $3,650,000, and having an annual output of $14,228,000. The city has a system of sewerage designed by the late Mr. CHEESEBROUGH, M. Am. Soc. C. E., on which $200,000 have already been expended. Many of the streets are paved, and bonds for $500,000 have been voted for 20 miles of street work. Main St. is being paved with granite blocks on concrete foundation, and a double-track street railway with girder rails on chairs, is being laid at the same time. There are several street railways and electric railways to the suburbs, and the city has also water supply, gas and electric light, and other public improvements. There are two railway stations, at which 52 trains arrive and depart daily, and the annual freightage amounts to about 6,798,400 tons. The Belt Railway is an important feature in the development of the industries of the city, having about 50 miles of line, connecting the several roads which enter the city, and having spur tracks into all the manufacturing establishments, so that any factory, etc., can receive and ship freight direct. Extensive improvements are to be made on this line and on the broad-gage road up Lookout Mountain (Chattanooga & Lookout Mountain R. R.), which has been acquired by the Belt Line. The new bridge across the Tennessee River to North Chattanooga was described and illustrated in our issue of May, 16, 1891.

A party of about 23 visited Birmingham, Ala., leaving Chattanooga at 9 A. M. May 26, by the Alabama Great Southern R. R., which is one division of the Cincinnati, New Orleans & Texas Pacific Ry., or the Queen & Crescent route. The observation car of Mr. GEO. B. NICHOLSON, Chief Engineer of this route, had been run from Cincinnati to Chattanooga with the special train, as already noted, and Mr. R. MONTFORT, Chief Engineer of the Louisville & Nashville R. R., who was one of the party, very kindly provided his observation car and a day car for the use of the party from Chattanooga to Birmingham, and thence north to Nashville over his road, thus giving very comfortable facilities for traveling and for seeing the construction of the road and the scenery along the line. A stop for dinner was made at Attalla. Birmingham, 143 miles, was reached about 3:30, and a reception committee conducted the party to the Caldwell House, and later took them for a ride on the Highland Avenue & Belt Line, one of the numerous city and suburban steam dummy lines for which Birmingham is noted. The city is in process of development and has not yet acquired an appearance of completeness. It is substantial looking, however, having many brick and stone buildings, good office buildings, wide streets, brick paving in some places, and several local industries. Its population is about 50,000. A number of railways center here. Some of the streets are carried across the tracks by bridges, with viaduct approaches, and other bridges are to be built for the same purpose. The dummy lines run through the streets, and are operated by engines with 4 coupled wheels, some having a Bissell truck under the tank. Some of the cars are open, with transverse seats; others are closed, and have seats along the sides. Some of the trains consist of 4 cars. A pleasant reception was tendered the party in the evening by the Alabama Club, at its rooms, but owing to the short notice of the arrival of the visitors the attendance of members of the club was rather small. On May 27 the party started in a special train for a trip over the Birmingham Mineral R. R. for the purpose of visiting some of the ore mines and steel works around the city. The train consisted of the 2 special cars and a refreshment car provided by the Birmingham Business Men's and Industrial Association, members of which were present to help the visitors to obtain a good impression of the importance of Birmingham and its interests. The Birmingham Mineral R. R. is owned by the Louisville & Nashville R. R. and has about 165 miles of track connecting the numerous outlying manufacturing districts, such as Ensley, Bessemer, Gate City, etc., with the main lines of railway, and having spur tracks to the steel works, ore mines, manufactories, etc. A stop was made at the Eureka ore mines, where the rock is got out from an open quarry and from tunnels, and another very brief stop was made at the Ensley furnace. It was unfortunate that time and pressure of business required the party to hurry away so soon, as there is very much of interest to see in this wonderful mineral region. Negotiations are now in progress looking to the erection of a combined open-hearth and Bessemer steel plant by the Tennessee Coal & Iron Co., at a cost of $800,000. A vote of thanks was tendered to the local committee for their hospitality, and the two special cars were then attached to the 11.20 A. M. northbound express to take the party to Nashville, which was reached about 7.30 P. M. Mr. MONTFORT entertained the party at dinner in his private car, and did everything to make the trip pleasant and agreeable to his guests, who were unanimous in their appreciation of his courtesies. At Nashville the party proceeded to the Duncan House on the electric cars, being particularly struck during the ride by the frequent and vivid flashes of lightning from under the car, illuminating the whole width of the street.

On May 28 the visitors were taken in charge by Mr. OLIN H. LANDRETH, professor of civil engineering at Vanderbilt University, and Col. CHARLES A. LOCKE, both local members of the Society, who provided carriages and drove the party to different points of interest, including the Cumberland River bridge, the State House, the masonry reservoir of the water-works (from the top of which there is a fine view of the city and surrounding country), and then to Vanderbilt University. This is a very fine institution, with handsome and well-equipped buildings, situated in park-like grounds. The civil and mechanical engineering departments, the latter of which is under the charge of Professor MAGRUDER, were of especial interest, the class-rooms, engine and boiler rooms, shops, testing-room, etc., being all visited and examined. The visitors were then pleasantly entertained at luncheon at the residence of Mr. and Mrs. LANDRETH, and again regretted that they had to hasten away from the hospitable attentions paid them during their visit to the South. Nashville is a prosperous looking business city, and has very fine suburban residence districts. It is a comparatively old city, and therefore more attractive and artistic in several ways than the newer towns of the South. Its appearance is from a distance rather spoiled by the smoke from the neighboring factories and works, but this is an objectionable feature common to all towns where soft coal is used for fuel. The city is well provided with electric cars, using the overhead wire system, and high speeds are attained and steep grades surmounted. A runaway accident occurred, however, on the day of the party's visit, an electric car getting beyond control on a steep grade and colliding with a car standing at the bottom. A dummy line also runs out to a resort known as Glendale Park, pleasantly situated about 7 miles from the city. The line runs through the streets, and outside the city is built across country like an ordinary railway. The engine is a four-wheel Baldwin dummy, burning soft coal. Like most engines of its kind, it is worked with very little care and attention, and has a rather dilapidated appearance. As a general thing it seems to be supposed that a steam dummy engine can be run without the skilled attention given to other kinds of locomotives and steam engines, and the results may account for a part of the prejudice against these motors for city streets. The census population of the city is about 78,000; but it is explained that owing to the high city taxes many people live outside the city limits, and that the population of what would really be considered as the city is nearly 100,000.

Here the party broke up, some going east by Chattanooga, Knoxville and the Shenandoah Valley, and others by Louisville, Cincinnati and Cleveland, while some stopped on their way to visit the Mammoth Cave, near Glasgow, Ky. They had all enjoyed the excursion and appreciated the attentions and courtesies shown them, and all would have been glad to spend more time in studying the resources and industries of the New South.

The following is a list of members present at the conventi n:

John B. Atkinson, Earlington, Ky.; John W. Bacon, Danbury, Conn.; Wm. D. Bullock, Providence, R. I.; Charles E. Billin, Steelton, Pa.; G. Bouscaren, Cincinnati, O.; Ward Baldwin, Cincinnati, O.; P. F. Brendlinger, Yonkers, N. Y.; Charles H. Brush, New York City; Dexter Brackett, Boston, Mass.; B. J. Burke, Newark, N. J.; Fred Brooks, Boston, Mass.; G. H. Benzenberg, Milwaukee, Wis.; L. L. Buck, New York City; D. Bontecou, Kansas City, Mo.; Julius Baier, St. Louis, Mo.; R. L. Cobb, Louisville, Ky.; O. Chanute (President), Chicago, Ill.; G. S. Clark, Cedartown, Ga.; W. H. Courtenay, Louisville, Ky.; F. Collingwood (Secretary), Elizabeth, N. J.; Miss E. G. Crane, New York City; R. A Cummings, Roanoke, Va; B L. Crosby, St. Louis, Mo.; H. St. L. Coppee, Vicksburg, Miss.; S. B. Downes, New York City; Paul Didier, Alleghany, Pa.; G. S. Davison, Pittsburg, Pa.; Robert L. Engle, Cincinnati, O.; George E. Evans, Lowell, Mass.; O. Erlandsen, Mt. Carmel, Pa.; W. E. Foster, Nashville, Tenn.; John R Freeman, Boston, Mass.; James B. Francis, Lowell, Mass.; A. B. Fitch, Chattanooga, Tenn.; Geo. H. Frost, New York City; John A. Fulton, Cleveland, O.; H. Frazier, Huntington, W. Va.; J. L. Frazier, Louisville, Ky.; Bernard R. Green, Washington, D. C.; John M. Goodwin, Sharpsville, Pa.; Charles E. Goad, Montreal, Canada; Henry Goldmark, Kansas City, Mo.; Charles E. Greene, Ann Arbor, Mich.; P. H. Griffin, Buffalo, N. Y.; Wm. Gibson, Jr., New York, N. Y.; Wm. P. Harris, Johnson City, Tenn.; Horace E. Horton, Chicago, Ill.; James H. Harlow, Pittsburg, Pa.; A. Hider, Greenville, Miss.; B. M. Harrod, New Orleans, La.; Robert W. Hunt, Chicago, Ill.; G. F. Haynes, Boston, Mass.; R. Hering, Philadelphia, Pa.; W. E. Hoyt, Rochester, N. Y.; D. C. Humphreys, Lexington, Va.; B. D. Hasell, Brooklyn, N. Y.; Wm. C. Jewett, Chattanooga, Tenn.; Gustave Kaufman, Pittsburg, Pa.; W. R. King, Willett's Point, N. Y.; G. W. Kittredge, Indianapolis, Ind.; Joseph M. Knap, New York City; Thomas D. Lovett, Cincinnati, O.; William H. Lotz, Chicago, Ill.; G. Lindenthal, Pittsburg, Pa.; Thomas B. Lee, New York City; Sidney F. Lewis, New Orleans, La.; Olin H. Landreth, Nashville, Tenn.; H. McDonald, Atlanta, Ga.; R. C. Morris, Nashville, Tenn.; William Metcalf, Pittsburg, Pa.; E. T. D. Myers, Richmond, Va.; R. C. McCalla, Tuscaloosa, Ala.; William E. Merrill, Cincinnati, O.; John MacLeod, Louisville, Ky.; Gouv. Morris, Johnson City, Tenn.; Thomas H. McCann, Hoboken, N. J.; Marshall Morris, Louisville, Ky.; John J. McVean, Grand Rapids, Mich.; A. L. Mills, Toledo, O.; Robert Moore, St. Louis, Mo.; George S. Morison, Chicago, Ill.; R. Montfort, Louisville, Ky.; George B. Nicholson, Cincinnati, O.; Alfred Noble, Memphis, Tenn.; Edward P. North, New York City; James Owen, Newark, N. J.; Frank C. Osborn, Cleveland, O; C. O. Parker, Jacksonville, Fla.; Henry G. Prout, New York City; Alfred Petry, Covington, Ky.; Arthur Pew, Talbotton, Ga.; S. Rea, Baltimore, Md.; W. B. Ruggles, Cincinnati, O; Robert L. Read, Cincinnati, O.; Henry B. Richardson, New Orleans, La.; William Roberts, Waltham, Mass.; T. F. Richardson; William P. Shinn, Pittsburg, Pa.; T. Guilford Smith, Buffalo, N. Y.; Frank W. Skinner, New York City; L. W. Stubbs, Monroe, La.; William Scherzer, Chicago, Ill.; Robert Somerville, Greenville, Miss.; Edward S. Safford, Shelby, Ala.; Charles Seymour, Madisonville, Ky.; H. R. Stanford; Stevenson Towle, New York City; E. E. R. Tratman, New York, N. Y.; John C. Trautwine, Jr., Philadelphia, Pa.; John Thomson, New York City; E. Thacher, Louisville, Ky.; Ben. Thompson, Chattanooga, Tenn.; W. G. Wilkins, Pittsburgh, Pa.; James E. Willard, Cincinnati, O.; Herbert M. Wilson, Washington, D. C.; William H. Wiley, New York City; Arthur Owen Wilson, Huntsville, Ala.; S. Whinery, Cincinnati, O.; C. F. Wood, Knoxville, Tenn.; C. D. Ward, New York City; N. J. Welton, Waterbury, Conn.; J. S. Walker, Birmingham, Ala.; F. C. Weir, Cincinnati, O.; C. P. Yeatman, Cincinnati, O.

ENGINEERING NEWS

AND

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GEO. H. FROST.....BUSINESS MANAGER

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia.—June 6. Secy., Howard Murphy, 1122 Girard St.

American Society of Swedish Engineers.—June 6. 250 Union St., Brooklyn, and 347 North Ninth St., Philadelphia.

Engineers' Club of Kansas City.—June 8. Rooms, Baird Building. Secy., H. Goldmark.

Civil Engineers' Club of Cleveland.—June 9. Secy., A. H. Porter, 50 Euclid Ave.

American Railway Master Car Builders' Association.—June 9. Annual Convention, Cape May, N. J.

Denver Society of Civil Engineers.—June 9. Secy., Geo. H. Angell.

Civil Engineers' Association of Kansas.—June 10. Secy., J. C. Herring, Wichita, Kan.

New England Water-Works Association.—June 10-12. Annual Convention, Hartford, Conn. Secy. R. C. P. Coggeshall, New Bedford, Mass.

Engineering Association of the South.—June 11. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Northwestern Track and Bridge Association.—June 12. Secy., D. W. Meeker, St. Paul, Minn.

American Railway Master Mechanics' Association.—June 16. Annua Convention, Cape May, N. J.

Engineers' Society of Western Pennsylvania.—June 16. Secy., J. H. Harlow, Pittsburg, Pa.

International Association of Car Accountants.—June 16, 17. Annual Meeting at Denver. Secy. S. P. Sechrist, 92 Pine street, New York.

American Society of Mechanical Engineers.—June 16-20. Annual Convention, Providence, R. I. Secy., F. R. Hutton, 12 West Thirty first street, New York.

Engineers' Club of St. Louis.—June 17. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

Boston Society of Civil Engineers.—June 17. Secy., S. E. Tinkham.

Association of Railway Telegraph Superintendents.—June 17. Annual meeting at Cincinnati, O., Grand Hotel.

Engineers' Club of Cincinnati.—June 18 Secy., J. F. Wilson.

Western Society of Engineers.—July 1. Secy., J. W. Weston, 380 La Salle St., Chicago.

Engineers' Club of Minneapolis.—July 2. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Association of Civil Engineers of Dallas.—July 3. Secy., E. K. Smoot, 803 Commerce St.

Technical Society of the Pacific Coast.—July 4. Secy., O. von Geldern, 819 Market St., San Francisco.

Civil Engineers' Society of St. Paul.—July 6. Secy., C. L. Annan.

THE United States Patent Office has just issued a revised classification of subjects of invention, the use of which may not be as familiar as it should be to engineers who do business with the Patent Office without the aid of an attorney. All inventions are classified in the Patent Office, and each class is divided into various subclasses. The present classification, adopted Jan. 1, 1891, contains 200 classes, which are subdivided into 4,297 subclasses. A person who wishes to inform himself as to the "state of the art" in any line of invention can order copies of all prior patents of the sub class to which the invention belongs. The number of existing patents in any subclass will be given on application to the Patent Office. Persons wishing to keep informed as to the progress in any line of invention may have copies of the patents in the subclass to which it belongs mailed to them as fast as printed by making a small deposit with the office. The revised classification referred to above was issued as a supplement to the *Official Gazette*. It can doubtless be obtained separately, however.

THE rapid transit route for New York, so far laid down by the Commission and proposing practically a deep underground railway, has naturally awakened to life all rival schemes, and the papers of the city are filled with objections to the project, as these present themselves to those who have other plans in view. We believe the Commission has arrived at a very sensible conclusion, one that presents the fewest obstacles to success in a many-sided problem. The objection that money enough cannot be found to build it is delightfully absurd, coming as it does generally from the advocates of a surface route. As New York will never again be likely to permit the use of its street surface for rapid transit lines, a surface route practically means the purchase of real estate, to begin with, at a cost that would practically build the underground road entire, which should cost little or nothing for right of way. But the subject is too broad for discussion here, and we shall have more to say in another issue.

THERE is good reason for the proposed modest outlay of about $20,000 for a fire-proof and centrally located storage house for the plans and records of the new Croton Aqueduct. And though the Corporation Counsel has ruled that the Aqueduct Commission has no power to order the construction of such a building, we fear the time will come when there will be serious cause to regret this adverse action. These plans are the only record of an extremely complex structure; one of great magnitude and of vital importance to after generations of citizens of New York. The time may too soon come when ready access to one of these plans may mean more in dollars than a dozen buildings of the type proposed. Even if stored away in the new municipal building, which is not yet commenced, they would be neither as accessible, safe nor well cared for as they would be in the separate structure at the 135th St. gatehouse.

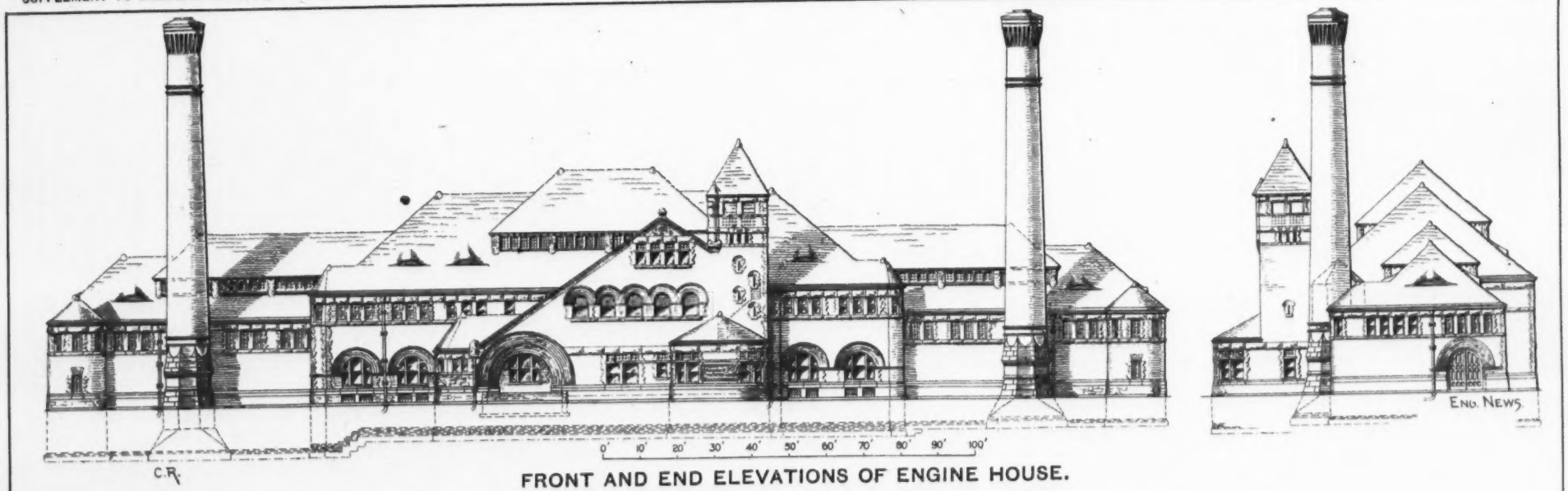
This failure to recognize the value of engineering plans and records, and the necessity of properly preserving and filing them for reference, is by no means peculiar to the Corporation Counsel of New York City. Many other of our larger cities and corporations and the great majority of smaller towns are notoriously careless in this respect. Entirely too many officers, responsible for the so-called business management of large and small interests, seem to believe that the engineer's work begins and ends with construction; that his plans are only means to an end; and that when this end, viz., the completion of the work, is accomplished, these plans and their detail records are no longer of any value, and may safely be consigned to the dust bin or to the junk shop. They forget entirely that dams, in the future, may leak, that bridges and other structures may fail in some part, or that alterations and extensions may be some time necessary to either or both. When this time comes, carefully made detail plans, showing the work as finished, can alone be trusted to as a safe guide for any further work. And the attempt to do so without these, or to reconstruct by actual survey work more or less hidden under ground or water, will certainly entail an expenditure, and may entail a loss, that will far exceed the cost of making and properly preserving these plans in the first place.

CAREFUL, wide-awake corporations recognize the value of these records. And the labor and money expended and the ingenuity displayed by some of our great railways and more advanced cities in preparing and making accessible the full detail of all construction work, prove that they have good reason for knowing that this care pays. In many cases which we have in mind, where personal search after records has only resulted in utter failure to get what we wanted, we can testify that the engineer is not himself to blame. The engineer, for his own convenience and the efficient conduct of his office, is usually willing enough to put and keep his house in order in this respect; but the lack of "an appropriation" is the too common stumbling-block in his way. Proper plans of completed work, in cities or on railways, mean time and money expended in their preparation, and well devised and well-managed appliances for keeping them on file. It might be mentioned that the city of New York has not as yet expended any considerable portion of its revenue in completing and filing the records of its many and complicated engineering works. And while we do not know what may be done in the new building, in the way of providing for their engineering department the quarters and staff needed for this service, we can say that past methods in this respect make the efforts of the Aqueduct Commission to elsewhere preserve the invaluable records of their great work both wise and commendable.

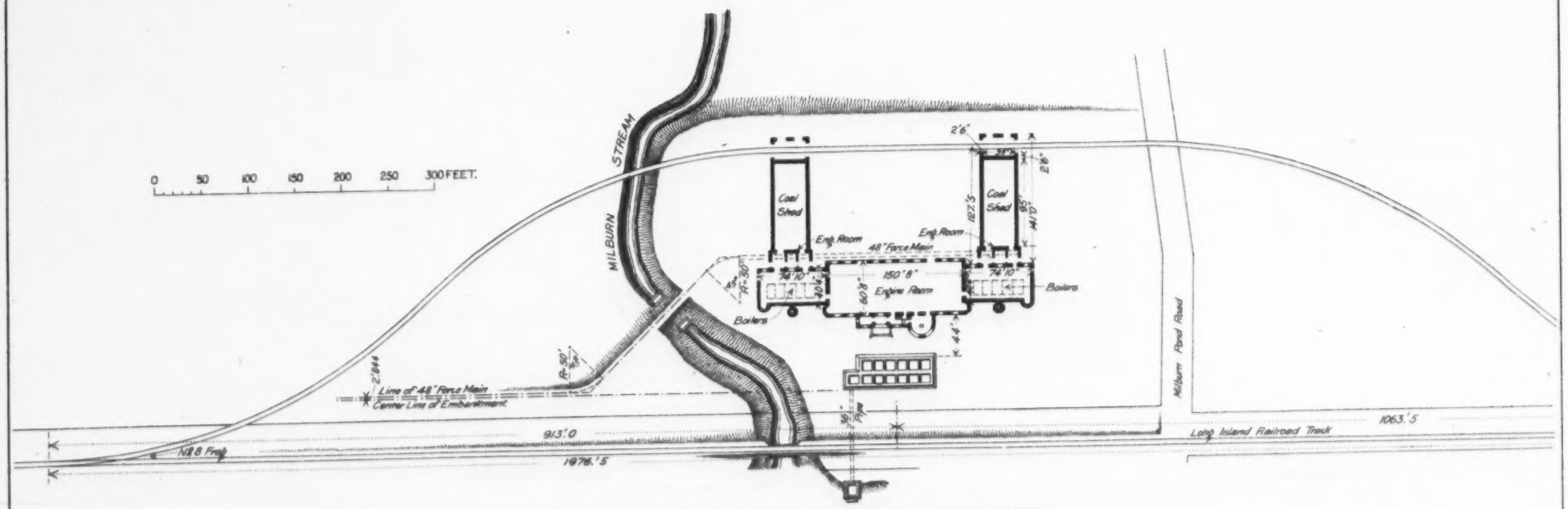
THE dense ig norance which the average inventor possesses on the subjects concerning which he desires to advance the world's practice is a peculiar phenomenon. Our recently published statistics showing that the Master Car Builders' type of automatic coupler has been adopted by railways controlling 61 per cent. of the freight cars of the country were widely copied in the newspapers. The result has been a string of letters to this office, asking for a description of the coupler adopted, and revealing that the writers were in blissful ignorance of the fact that the Master Car Builders' Association had ever adopted a standard coupler, or that any progress had been made in putting it into use.

The statistics which we presented showed with practically absolute certainty that no car coupler not of the vertical plane type has the ghost of a chance of financial success. Well-informed railway men all over the country have been aware of this for a long time. Of all this, however, the public in general and inventors in particular remain in dense ignorance, and during the first four months of the year no less than 270 patents were issued by the United States Patent Office to inventors of car couplings. Not more than a dozen or so at most were of the vertical plane type. The ordinary run of inventors are to be pitied for attempts to accomplish the impossible in mechanics, and they are certainly to be pitied for the time and money they waste on inventions which, however ingenious, have absolutely no chance of commercial success.

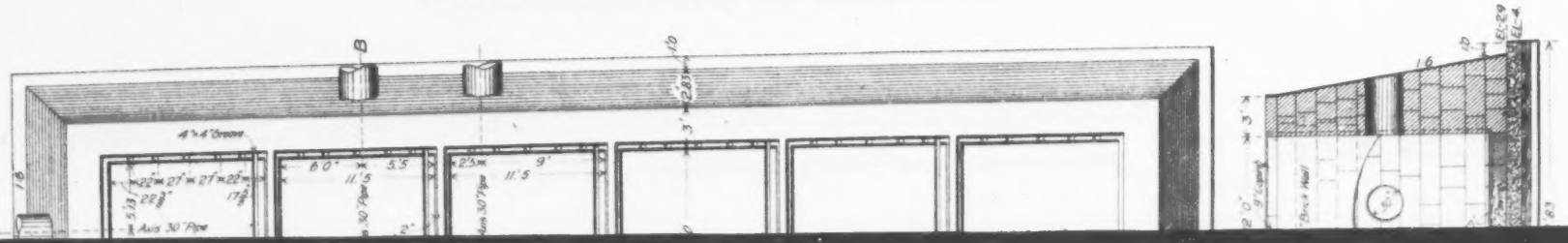
Reckoning the cost of each patent at $100, including office and solicitor's fees and a reasonable amount for the inventor's not very valuable time, it appears that about $75,000 per annum is still being squandered on car-coupling inventions by people who in most cases can ill afford to lose the money. Unfortunately this is only one of the numerous things on which inventors waste thousands of dollars in utter disregard of the laws of



FRONT AND END ELEVATIONS OF ENGINE HOUSE.



PLAN OF ENGINE HOUSE AND SURROUNDINGS.



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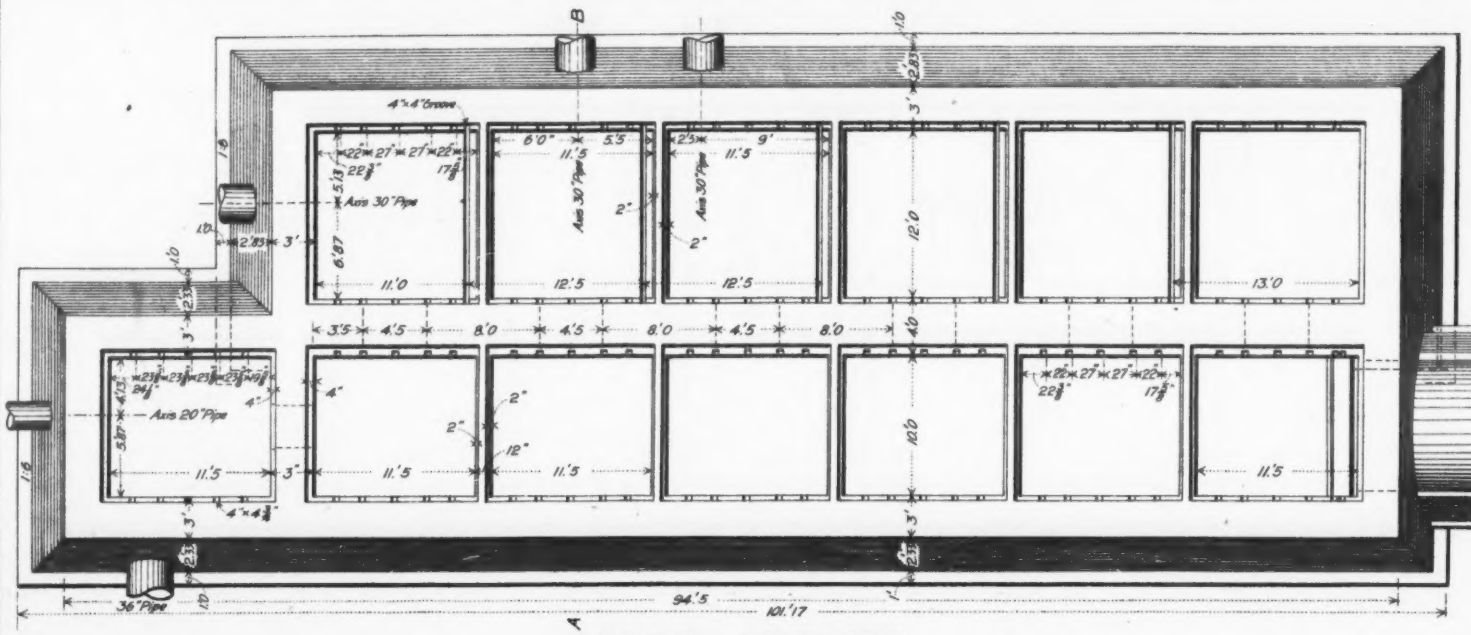
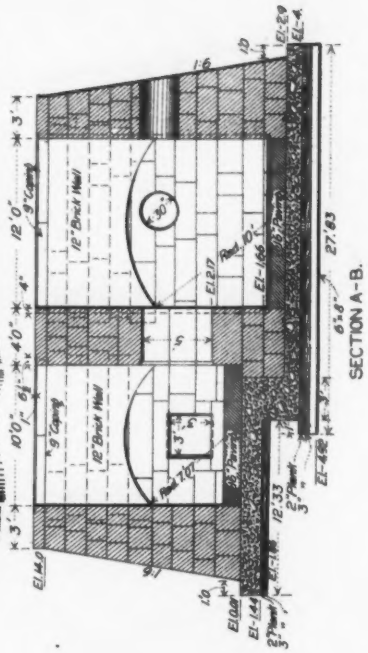
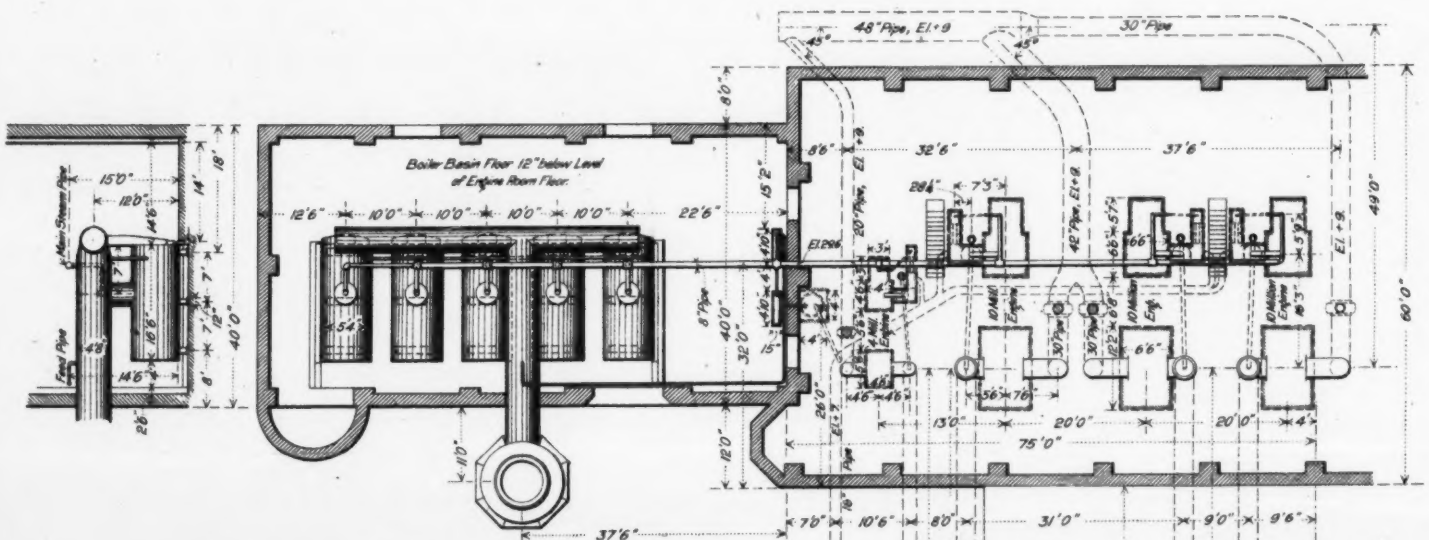




PUMP WELL AND POCKET.



ARRANGEMENT OF ENGINES AND BOILERS.

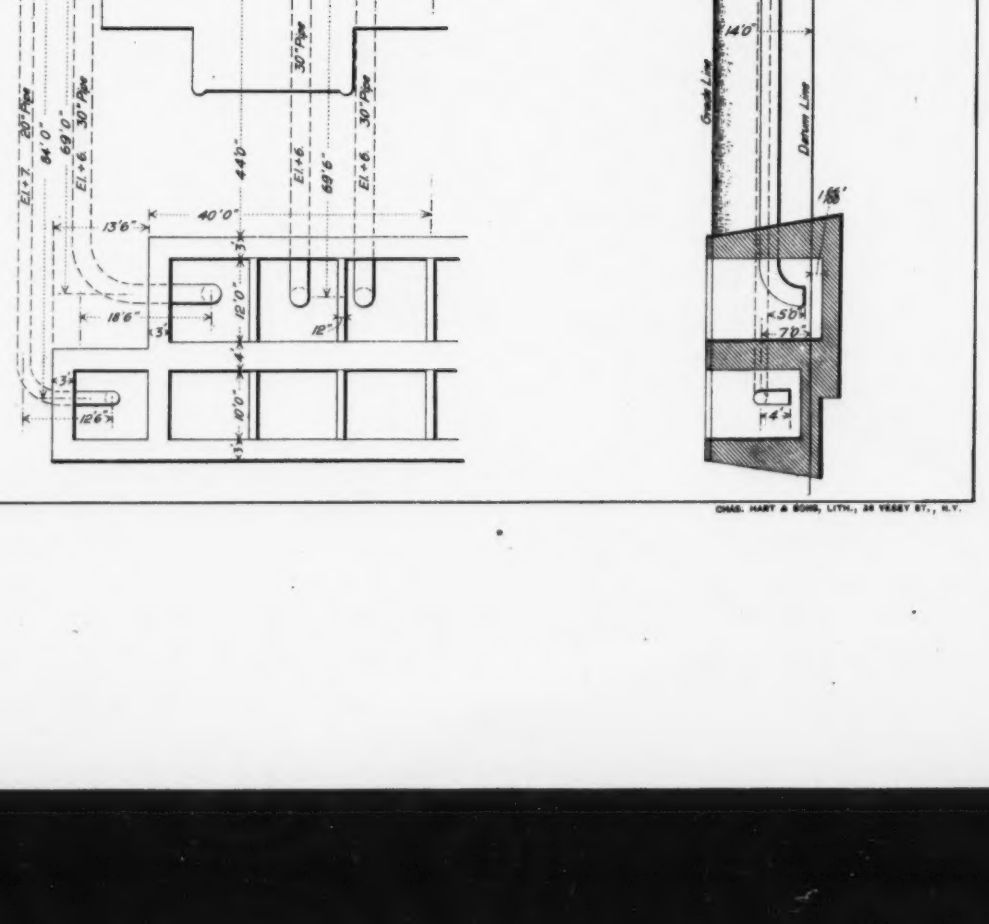
ARRANGEMENT OF ENGINES AND BOILERS.

THE BROOKLYN WATER-WORKS EXTENSION.

MILLBURN ENGINE HOUSE.

ROBERT VAN BUREN, CHIEF ENGINEER. I. M. DEVARONA, ASSISTANT ENGINEER IN CHARGE.

JOHN P. ADAMS, COMMISSIONER OF CITY WORKS.



CHAS. HART & SONS, LITH., 39 VESEY ST., N.Y.

mechanics, or the equally inflexible laws of supply and demand which regulate industry.

It is a fact worth notice in this connection that the pseudo-scientific journals run in connection with patent agencies, which circulate largely among inventors and are looked upon by them as oracles of wisdom, are uniformly careful to avoid publishing any facts which might interfere with the income of their patent soliciting department. The M. C. B. coupler may come into use never so rapidly, and all other couplers may be declared inapplicable to cars offered for interchange; but the readers of these journals will still be entertained and instructed by the frequent announcement that "RICHARD ROE, of Notown, has just invented a new and improved link-and-pin coupling for railway cars which avoids the numerous defects heretofore prevalent in car couplings." Publishing matter of this sort bears the same relation to real technical journalism that the business of a patent "shark" bears to that of a professional engineer of good standing.

A LEADING British technical journal, *Industries*, has an editorial in a recent issue which we may note in passing, simply by making two quotations from it, as they illustrate a tendency which we cannot but regard as in some degree peculiar to British journalism. Our own journals of every class show a perfect readiness to "jump on" things American which they think are bad, to point out how much better the same thing is done abroad, or how far we are behind, regardless of how unpleasant the truth may be at home, or how gleefully it may be received abroad. We think this tendency is all but universal on this side of the water; and we regard it as healthful and fortunate on the principle of the whist maxim that it is more important to inform one's friends than to deceive one's enemies. We see very little of this tendency in English journals of any class, however, but rather a preference for a tone very much like that of the first of the following quotations, to appreciate which fully it is necessary to remember that the superiority of the British navy in the seas surrounding Britain is vital to its very existence, and that there are reasons to fear that British naval practice is somewhat behind that of other nations in some important details to-day, as it has proved to be several times in the past. In commenting on "American Warship Design," *Industries* of April 10 says (italics ours):

> When the Americans first began to build ironclads under the inspiration of men like STEVENS and ERICSSON, the designs were of great originality, and, although the vessels were deficient in speed, they were, nevertheless, formidable instruments, both of offense and of defense. *At the present time the American authorities seem to be content to follow our lead.* As Mr. WHITE has remarked, all the details of our warships are obtainable for a few pence from the parliamentary returns, and many of the points in American ships are copied directly from those of the British navy.
>
> [Then, omitting a column and a half:]
>
> Among the cruisers there is one to which we would direct special attention, and that is "No. 12." She is called a "Commerce Destroyer," and is popularly known as the Pirate. She is intended to have a sustained sea speed of 21 knots. Mr. Secretary TRACY thinks this "vessel absolutely without parallel among the warships of the world, and that the combination there made unites a sufficient armament with complete protection against light guns, while at the same time the vessel will have a sea speed and a coal endurance hitherto unknown in ships of war. No merchant vessel that she meets, armed or unarmed, can escape from her." *From her design she seems likely to meet these expectations*, as she has ample power, sufficient armor, and guns and torpedoes which would quickly dispose of any merchant ship. The vessel is well devised, and would give a good account of herself against most cruisers. . . .
>
> *The activity and originality shown in connection with the recent development of the American navy afford material for thought*, not only to our shipbuilders, but also to our statesmen. Notwithstanding this activity we sincerely hope that the two great English-speaking nations of the world will never disgrace civilization by going to war with each other. We may say frankly that we should have preferred to see America content in developing her industrial and mercantile resources.

The Nicaragua Canal.

Our readers will note, from the matter already issued regarding the trip of Senator WARNER MILLER and his party over the line of the Nicaragua Canal, that we do not propose to deal at any length at least with the more technical details of this great work. We have already published in this journal the location, profile and estimates of quantities, etc., and have editorially discussed the engineering and commercial future of the canal. We do propose to show, however, some of the more important changes in the line, and such engineering details as were not accessible until lately.

The purpose of Senator MILLER, as President of the Nicaragua Canal Construction Co., was the very laudable one of personally inspecting the work actually done, and of judging for himself of the conditions under which future work would have to be conducted. This is not a usual course of action in the executive head of a distant enterprise, and there are few men occupying his position who would have exchanged the comforts of a New York office for the undoubted hardships and general discomforts attending a tramp of nearly 50 miles through a tropical jungle. But we can and do testify that he stoutly shared with the rest of us all the experiences of a trip that will not be soon forgotten.

Our own purpose in going to Nicaragua was to study the canal on the ground; and to study it rather from the standpoint of a constructor of works than from that of one seeking to test or to criticise engineering details. The country and conditions are novel to most of our readers, as they were to ourselves, and a personal inspection could alone satisfy and dispel or confirm certain preconceived ideas. We also were interested in the amount and character of the work already accomplished or under construction, and we have described these features as they appeared to us.

The one thing that we most feared was the probable unhealthy character of a country situated so close to the equator, and in part on a low and swampy coast. Panama was too near and the disastrous records of the French canal builders too fresh, to permit us to believe all the good that we had previously heard of the sanitary conditions along the newer canal. It is true that we personally knew many of the engineers engaged on this work, and from time to time saw them come back to New York and into our own office, browned but otherwise uninjured by their tropical sojourn. But there was just a chance that these men had been unusually careful of themselves, and had spent their time in Nicaragua under conditions very unlike those which would be encountered by the ordinary laborer. These were points that could only be settled by a personal visit; and short though it was, we believe we have sufficient evidence to warrant us in stating that, with the most ordinary precautions, there need be no fear of epidemics or serious illness among the workmen on the canal.

We give at some length in our narrative the record of the hospitals, climatic conditions and the methods of the company's officers in handling labor. And we can add to this the further evidence that out of about 20 in our party who spent nearly two months in this region, not one was in any degree affected by the climate otherwise than to a slight degree by its extreme heat. Yet this party of thoroughly unacclimated men seemed to defy all laws of hygiene, especially in the tramp through the forests and lowlands of what is deemed the most unhealthy portion of the canal route. They were wet by constantly recurring showers; slept in their wet clothing; tramped through the heat of the day when even the native advises and takes rest, and, partly through ignorance, in many reckless ways exposed themselves to climatic disease—had it existed. We do not know that any precautions were taken in the way of medicine for warding off attacks of this nature, and though we had with us a full medicine chest and two surgeons of the staff, their services were rarely called for, except to pick out thorns and extract "jiggers" from the unwary.

We do not for a moment claim that a man from the North can for an indefinite time safely defy sanitary precautions, and have little doubt that had our careless methods been continued long enough some of us, at least, would have paid the penalty. But as counter evidence, and as indicating that this region is not so "deadly" in its climatic effects as some writers claim, we believe it is sufficient. Why this country, only removed from Panama by about three degrees of latitude, should be so very much more healthy can only be explained by us by the fact that the invigorating Northeast Trades are stronger and more constant in the region of the Nicaragua Canal, the stratum of decayed vegetable matter seems much thinner, and finally, and most important in its bearing upon the general health, there are no old, plague-stricken cities in the neighborhood, reeking with the accumulated filth of generations and carrying in their soil the germs of disease. If disease were once introduced on the new ship canal, and its spread encouraged by careless and reckless administration among its officers and by dissipation in its worst form among the men, there is little doubt but that the natural conditions of heat and moisture are favorable enough for filling the hospitals to over-flowing. But it is evidently not intended that this state of affairs shall ever be permitted on the Nicaragua Canal.

The present canal administration is solving the health problem after a very sensible fashion; and this solution is the maintenance of strict discipline in its working force, proper food and shelter for the men, the strict policing of labor camps, and the proper location of these camps. This means practically the prevention of disease, or its reduction to its least dangerous form. When thousands of men take the place of the hundreds now employed, this policy will, of course, become more difficult of enforcement. But it is the right and only safe policy; and when adopted at the beginning of the work as it is there, we are sure that its good effects will warrant all the trouble it may entail. Healthy labor means cheap and efficient labor, and, all other conditions being equal, this in turn means the speedy and economical completion of the canal and its commercial success.

Next to health in the working force comes the question of labor supply. Jamaica, with its 400,000 negroes, will undoubtedly furnish all that is wanted in this respect. But as the Jamaican negroes are turbulent and much inclined to idleness and dissipation, they will have to be guided with a firm hand. They are strong, stand the climate well and are good workers under intelligent direction. There is also a goodly supply of native labor to be secured in Nicaragua, though these people would have to be kept separate from the negroes in camps and on the work. The Indian is patient, uncomplaining, works well at work he understands, and for packing loads and clearing out the jungle is invaluable. Contractors who have employed them in this region speak very well of them. They are faithful, thoroughly appreciate good treatment and will never strike; but they are quick to resent ill-treatment, and are very handy with a *machete* in their quarrels. They will not mix with and always are at odds with the Sambos, as they call the negroes.

One of the results of our trip across Nicaragua was a full appreciation of the herculean labor performed by the engineering staff of the canal company in locating its lines. No one who has not, in part at least, tramped over the trails made by the working force, can realize what it means to find the "best line" through this trackless wilderness of

tropical vegetation. And too much praise cannot, therefore, be accorded to the engineers who have furnished the raw material for the elaborate topographical maps of the whole country bordering this canal, which we found completed in the company's office or under preparation.

For the benefit of those who have never made a survey in a similar country it should be said that every foot of the line must first be cleared by the *machete* or long knife of the natives. Instruments, food, clothing and supplies of all kinds must be packed on the backs of Indians or of the engineers themselves, for no four-footed beast of burden can penetrate these woods, or cross the deep, narrow ravines, or climb the steep hills. Canoes were used here whenever possible for transport, but even then the streams were so blocked with logs that walking and packing is almost an easier task.

The foliage is so dense that cutting will alone enable a line to be followed; and preliminary sights from hill-tops and high trees, when these are possible at all, furnish no guide to the general conformation of the country. One of the peculiarities of the vegetable growth of this section is that the high trees grow in the ravines, and the trees become smaller as the hills are ascended. The result of this is that an extended view across the tops of the trees would indicate a densely wooded, flat country, instead of the very much broken up land that really lies below, out of sight. Near the coast, and in inland pockets between the hills, the lines had to be carried through lagoons, swamps and savannahs of "saw-grass," that in the wet season necessitated wading, sometimes to the neck.

Under conditions like these a thoroughly satisfactory survey requires the maximum of engineering skill and judgment, and the extreme of patient, persistent engineering labor. This country, as far as we penetrated it, showed the cuttings and stakes of many trial lines and cross-sections. But the office maps and stacks of field notes show better than anything else the real work performed. Seemingly wherever choice of route was possible trial lines have been run and tied across with other lines; streams affecting the canal have been followed to their sources, so that they may be most economically diverted; the problem of hydraulic power at the points of heaviest work has been studied and the whole line cross-sectioned at intervals of 100 ft. wherever the ground was rough enough to demand it. Through the deep cuttings diamond drill borings have been made at points about 1,000 ft. apart, and extending to the bottom level of the canal; and the cores extracted have been carefully preserved for future use in estimating the character of the rock work. What the transport and operating of this drilling machinery cost, in human exertion, can only be guessed at; for as it was impossible to use steam all these borings were made by hand. In addition to this, construction and permanent railways have been located for the divisions needing them; and a telegraph line, 57 miles long, has been cleared, and wires put up and operated by the canal company, connecting their headquarters at Greytown with the Nicaraguan system at Castillo, on the San Juan.

The general result of this wise but enormous engineering labor is a set of topographical maps of the country bordering the route of the canal through the rougher country that would do credit to any of our own states, and that far exceed in detail anything that we have ever seen performed in the investigation of similar public works in the United States. In this connection it should be remembered that while the length of the so-called canal, from ocean to ocean, is 169.5 miles, 142.7 miles of this is practically free navigation by lake and river. This leaves 26.8 miles of canal to be excavated from the solid ground. The hard work of the engineer has been practically confined, therefore, to the 30 miles between Greytown and the Ochoa dam, and to the 17 miles between Lake Nicaragua and the Pacific, or 47 miles in all. Of course the San Juan River was also examined critically from Ochoa to the lake. The office records show that for every mile of located canal nearly 100 miles of surveys were actually made under the conditions outlined above.

This feature of the thorough preliminary examination of the country to be traversed by the canal especially struck every member of our party as the best indication possible of the successful future of this work. Reliable and abundant material is now in possession of the company to enable its engineers, or the engineers of any other interested party, to compute for themselves the probable quantities and the character of the work to be done here. There need be no guess work about these quantities. What the execution of the work will cost will depend upon the capital at once available and the policy adopted by the company or the contractors in preserving the health of the working force, as before remarked. But if the policy already inaugurated is carried out to the end, we see no good reason why the prices affixed to these quantities should much exceed, if any, the cost of similar work in more favored regions. In fact, the dredging and railway building near Greytown have, so far, fallen far below the preliminary estimates of the company's engineers.

Our readers need not to be informed that it was the absence of the information that the Nicaraguan company has spent so much money to obtain, that was one of the chief obstacles in the way of success at Panama. The engineers of Mr. DE LESSEPS began at the wrong end in first spending untold millions on a site for a town; in buildings that were extravagantly planned and in many cases never used; upon hospitals that were magnificent, but were more efficient as gateways to the many burial grounds than as a means of curing disease among ignorant workmen left to take care of themselves; upon enormous quantities of plant that was often utterly valueless under Panama conditions; and, in fact, upon everything excepting a careful, systematic and thorough study of the engineering task the "sea-level canal" presented.

We have the authority of the French engineers themselves for the statement that to the end the ultimate disposal of that powerful agent for evil, the Chagres River, had not been settled upon; the roughest of preliminary plans alone existed for the barrage of this river, and its volume, flowage lines, methods of construction and ultimate cost were matters of pure guess-work. The failure to properly diagnose the strata of the Culebra cut resulted in developing a tendency to slip as soon as the excavation had been carried to any depth, that in itself practically forbade a sea-level canal, In fact, had all the data necessary for arriving at even an approximately accurate estimate of the ultimate quantities, character and cost of this canal been first carefully gathered, there would never have been a Panama Canal—or, at least, it would never have been promoted as an honest commercial enterprise.

The Panama failure is valuable, however, as an object-lesson; and it teaches that we can only hope for success, with an enterprise of such colossal dimensions, when it is run honestly and upon true business lines; with strict economy where this is possible, but with a lavish expenditure of means, after the proper channel for this expenditure has been settled upon by the most thorough preliminary study of all conditions. It also teaches that neither the engineer, capitalist nor general investor can afford to gamble upon his dumb-luck in building ship canals in this latitude and expect commercial success to follow the issue of a prospectus or two and the adroit manipulation of a Paris stock-market. Something much more solid is needed as the only safe preliminary to all such enterprises, and that is the work of the intelligent investigating engineer; the man who goes ahead of construction, and by carefully studying each route and its contingent conditions gathers the information that will enable the capitalist and investor to judge for themselves of the wisdom of furnishing the means for actual execution.

From the amount and character of this work done on the line of the Nicaragua Canal we believe that the material is all at hand for accurately footing up the cost; the commercial future has already been widely discussed and is assured; and the only thing needed is the necessary national interest in an American ship canal for the benefit of Americans. If we do not build it some other nation will—and profit by it.

The Brooklyn Water-Works Extension.

[WITH INSET.]

III.

(*Continued from page 440.*)

MILLBURN PUMPING STATION.

The general plan of the Brooklyn water-works extension, now in progress, was described in our issue of March 7, and details of the conduit and supply ponds were given on insets in that issue and the one for May 9. As has been already stated, the new supply is being secured by extending the old conduit in an easterly direction to connect with five new supply ponds.

At a point near the fifth pond, from the easterly end, the brick conduit terminates at the Millburn pumping station, from which the water from the five ponds is forced to the Baldwin storage reservoir. The brick conduit from four of the ponds terminates in a pump-well, and the water from the Millburn supply pond is brought to the same pump-well by a line of 36-in. pipe, about 100 ft. long. The location of the pump-well, pumping station, Millburn supply pond, and side tracks of the Long Island Ry., for supplying the station with coal, are shown by the general plan on the accompanying inset. The inset also shows the arrangement of the engines, boilers and appurtenances, details of the pump-well and pocket and a side and end elevation of the station.

The engine-room proper is 60¾ × 150¾ ft. outside, not including the entrance vestibule and tower. The boiler-room wings are each 40½ ft. × 74 ft. 10 ins. outside, and each has a coal shed extending to the rear, 35 × 95 ft. inside of the coal room. There are rooms between the engine and boiler rooms, and a shed is carried out over the railway tracks at the rear of the coal sheds, as shown by the general plan.

The engine-room is entered from the front and the boiler-rooms from the ends. The building is well lighted, and both the window openings and the roof lines are well adapted to a pleasing architectural appearance, which is increased by the chimneys near each end. The materials used in the building will be mentioned further on.

The half plan of the engine and boiler rooms shows the disposition of the engines and boilers, their connections and the connections of the engines and pump well. At the start three 10,000,000 and one 4,000,000 gall. Davidson pumping engines will be used, but there is provision for six 10,000,000 gall. engines and two batteries of five boilers each. The pumps and boilers will be fully described and illustrated in a later issue.

Water is conveyed from the pump-well to the pumps through 30-in. pipes for the large and a 20-in. pipe for the small pump. Each pump has the same sized force main leading from it and joining the 48-in. force main to the reservoir in the manner shown by the plan, the mains from the two large end pumps joining to form a 42-in. main. Cross sections through the boiler and engine rooms give some further details of the boilers, pumps and connections, but as these will be described so fully in another issue, no more need be said here regarding them.

The brick conduit from the supply ponds terminates in a pocket parallel to and connected with the pump-well, as shown by the details on the inset. A sliding gate at the end of the conduit can be used to shut off the water from the pocket and pump-wel

A separate well, at the extreme left, receives the supply from the Millburn Pond, but this well is connected with the pocket by an opening 3 ft. sq. Excluding this well, the pocket and pump-well together form a stone-masonry structure 32 × 80 ft. to the outside of the top, having a foundation 40 ft. 2 ins. × 87 ft. 8 ins. The outer walls are 3 ft. thick at the top and batter 1 in 6, from the bottom of a 9-in. coping. The wall separating the pocket and pump-well, longitudinally, is 4 ft. thick, and is pierced by six openings, 4½ ft. wide by 5 ft. high. Both the pocket and the well have a 16-in. cut-stone pavement, that of the pocket being on about 18 and of the well on about 12 ins. of concrete, the concrete in each case resting on a platform of 2, then 3-in. plank, or 6 × 8-in. timbers, laid flat. The floor of the pocket and the well being on different levels, the concrete foundation beneath is joined, as shown on section *E F*.

The upper part of both the pocket and the well is divided into six sections by 12-in. brick-arched walls, with their crowns about 6 ft. from the top of the structure. The pocket has a depth of about 13 ft. 4 ins., and the well a depth of about 16 ft. 4 ins.

The chimneys, shown on the elevations, have a total height of 106 ft. above the ground, or 104½ ft. above the floor line of the station. The base is of stone and octagonal, while the main part is of brick. The octagon has a diameter of 13 ft. 9 ins. at the ground, and below the ornamental top the chimney is 8 ft. 4 ins. sqare.

Further information regarding the materials and methods of constructing the station are abstracted from the specifications as follows :

The building is of selected, hard-burned Haverstraw brick, in hydraulic cement mortar, with trimmings of stone, pressed and molded brick. The walls, stoop and chimneys have footing courses of concrete. The concrete for the walls of the engine and boiler houses is 18 ins. thick and 36 ins. wide. The concrete for the chimneys is 24 ins. thick and 22 ft. square. The cellar floor is covered with 4 ins. of concrete. The whole thickness of the walls of the building is of brick, the inside wall being faced with light-colored pressed Anderson brick or others as good. The walls of the boiler houses and of all walls and piers below the damp proof course are solid, and all walls above have a 2-in. air space, 12 ins. from the outer face of the wall.

The roof of the building is to be of slate, the gutters and leaders of galvanized iron, and the finials, ridge caps and hip rolls of terra cotta.

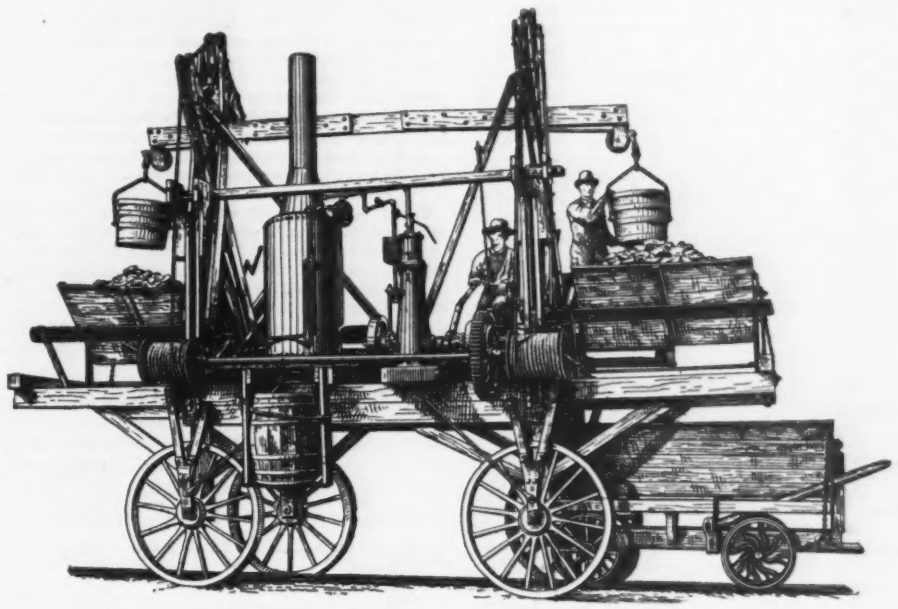
(To be continued.)

The White Excavating and Hoisting Machine.

The accompanying illustration shows an excavating machine mounted on wheels and designed especially for ditching in sewer construction. The machine consists of a double hoisting apparatus with receptacles for the excavated dirt. The hoisting apparatus overhangs the side of the machine, but by an automatic device each bucket is swung over its dirt receptacle when hoisted to the top. The emptying of the bucket also automatically brings the hoisting boom into position to lower the bucket into the ditch. At the bottom the rope is detached from the empty bucket and attached to a full one, which is hoisted to the top as before. As seen by the cut, the machine is set high on its wheels, and the space beneath it is left all clear, so that a car can be run underneath the machine, and the contents of the dirt receptacles at each end can be dumped into it. The car is then run back, and its contents are dumped in the completed part of the ditch. The method of connection of the hoisting engine to the winding drum is plainly shown in the drawing. It will be seen that both buckets are hoisted at once. The hoists are 18 ft. apart, hence if the shovelers work 9 ft. each way from the bottom of each bucket, 36 lin. ft. of the ditch will be made at each setting of the machine.

In operating machines in large ditches where there is more dirt than can be put back in the sewer, the dirt is drawn away by teams to the depth of 5 ft. In smaller ditches it is simply thrown up on one side, the machine working on the other. When the depth of 5 ft. is reached the first rangers and braces are put in and the sheathing is set. Work is then begun with the machine and continued until it is necessary to drive down the sheathing. The machine is then moved forward to the next 36-ft. section, and works there while the preceding section is put in shape for further operations.

In ground where excavation is not too difficult, it is stated that the machine will handle 350 to 450 cu. yds. of dirt in 10 hours, hoisting it from a depth of 5 to 20 ft. The machine is made by the White Excavating Machinery Co. of Minneapolis.



THE WHITE EXCAVATING AND HOISTING MACHINE.

Abstracts of Papers Read at the Cleveland Meeting of the American Institute of Mining Engineers.

CHINESE SILVER MINING IN MONGOLIA.

In this paper Mr. H. F. DAWES, of Englewood, N. J., described in a very interesting way the crude tools and processes by which the Celestials living in the province of Mongolia, north of the great Chinese Wall, manage to dig, smelt and refine silver ore. China undoubtedly possesses great mineral wealth, but with the methods employed its extensive development is quite out of the question. There are arts and industries which have reached great perfection without the aid of the engineer, but mining is not among them. The habits and prejudices of the Chinese are such that at present it seems extremely doubtful whether a foreigner can obtain any interest in mines of any kind ; and until this is done the chance for the mineral development of the country is decidedly poor.

THE CONSTRUCTION OF DETAILS FOR A MODERN LIXIVIATION PLANT.

In its general form this paper was one of the best presented at the Convention. The author, Mr. C. A. STETEFELDT, of San Francisco, described in a practical way the construction of a plant for treating silver ores with hyposulphite solutions. The corrosive action on metals of the solutions used makes the problem of pumps, pipes, cocks, valves and other machinery for handling the liquid one of considerable difficulty. Ordinary pumps cannot be used, and in their place ejectors, geyser pumps or the "Montejus" is used. The geyser pump is a long pipe open at both ends, the lower being immersed in the solution to be raised. Compressed air is forced in at the lower end and causes a flow upward in the pipe. A "Montejus" is an iron tank from which a solution is raised through a pipe by admitting steam or compressed air above the solution. The paper was of practical interest, however, only to the few engineers who have to do with silver ore treating plants.

A COMPOUND-PLUNGER HYDRAULIC PUMP.

This was a brief paper describing a hydraulic pump for use in place of the ordinary Cornish pump for raising water from deep shafts. The author proposed a simple direct-acting pump, the high-pressure cylinder worked by hydraulic pressure due to a gravity head, or, where this could not be had, a high-pressure pump could be placed on the surface. The system was not stated by the author to be in practical use at any place, but was merely suggested as a good scheme for trial.

GEOLOGICAL NOTES ON THE MANGANESE ORE DEPOSIT OF CRIMORA, VIRGINIA.

As we noted in a recent abstract from a census bulletin, the Crimora ore deposit is the most important source of manganese ore in the United States. The author, Mr. CHAS. E. HALL, of Chicago, described the geology of this deposit, which he said it would be well for manganese-ore prospectors to bear in mind, even though many of the features described might be peculiar to that special deposit. His theory of the origin of the ore is that it was dissolved from the Potsdam sandstone, through which it iss widely scattered, and was redeposited in the clay.

NOTES ON SOME OF THE MAGNETITES OF SOUTH-WESTERN VIRGINIA AND THE CONTIGUOUS TERRITORY OF NORTH CAROLINA.

The best known deposit of Bessemer iron ore in the South is the magnetic ore at Cranberry, N. C. The vein of which this is a part continues in a northeasterly direction into Virginia; but to what extent the ores along the vein may be profitably worked is an undertermined question. Mr. H. B. C. NITZE, of Baltimore, described in a paper with the above title a hasty prospecting tour along the line of this magnetic ore lead from Rocky Mount, Franklin Co., Va., to the vicinity of Danbury, N. C. Some desultory mining and developing has been done at many points, but no very well-directed efforts to determine the value of the mines at various places seem to have been made. The quality of the ore appears to be excellent, phosphorus running below 0.01% in many cases, and sulphur also being gratifyingly low. There are certainly fair chances of valuable mines being developed in this section, although none of the openings as yet made seem to promise more than a fair working profit. The value of these ores, of course, lies in their quality, which makes them suitable for the manufacture of steel by the Bessemer process.

STONE COAL IN THE LEAD BLAST FURNACE.

This paper was of interest to those engaged in the smelting of silver-lead ores. The author quoted several precedents for the use of non-coking bituminous coal in place of coke. He then described his experiments with this coal in the blast furnaces of the Harrison Reduction Works at Leadville, Colo. With about 27% of coal in place of coke in the fuel charge, a saving is made in fuel cost amounting to

25 or 30 cts. per ton of material smelted. Besides this there are certain practical advantages in the working of the furnace which make a further saving of about the same amount.

PHYSICAL AND CHEMICAL EQUATIONS OF THE OPEN-HEARTH PROCESS.

This was a discussion of the exhaustive paper on the above topic read by Mr. H. H. CAMPBELL, of Steelton, Pa., at the International Meeting last October. The greatest item of loss from an open-hearth furnace is in radiation, and this may be lessened by building the brickwork thicker or by covering the roof with a layer of sand. To reduce the temperature of the waste gases, the size of the regenerators may be increased.

EXPLOSIONS FROM UNKNOWN CAUSES.

This paper was also a discussion, the author, Mr. GEO. ROSS GREEN, of East Orange, N. J., being familiar with the factory described by Mr. JAS. C. BAYLES in his paper with the above title presented last October. He did not attempt to answer Mr. BAYLES' conundrums, however, but instead described some further gas and air explosions difficult of satisfactory explanation.

Some Methods of Meeting the Ordinary Requirements of Railway Maintenance.

(*Continued from page 521.*)

Following the lines of argument noted in the preceding and having found that an opening must be kept and that neither a rectangular nor an arched section can be used, we have to fall back upon:

Fourth. A pair of abutments and a bridge, with or without intermediate piers. In choosing the form of abutments we have to choose from either **T**, **U**, "angle" wing, or "straight" wing types, which are given here in the inverse order of desirability.

A straight wing abutment seems always best for a dry opening, if not prevented by local considerations; because the foundation is easier to put in, the coffer-dam is of a better shape, disturbance to the existing bank is less in case of extension for a second track, while cutting stone is less expensive, and extension for a second track is as easy as in any other form, and perhaps easier.

If the abutment is at the edge of a rapid stream, a straight abutment is liable to allow wash behind the wing walls at high water, and therefore wings at varying angles may be desirable. Keeping strictly to the same basis of thickness in all particulars, wings making an angle of 30° with the face are most economical of material. A slight flare to wings may be secured, as shown in Fig. 11, while keeping a straight back line of masonry.

[An important point in regard to arch culverts with flaring wing walls, not noted here, is that they should always have the form *A* in plan, Fig. 11a, and never the form A^1, with square shoulders on each side. The form A^1 is the more common, owing to the supposed difficulty of intersecting the vertical face of the abutment with the (usually) battered face of the abutment; but this is no real difficulty. The intersection is at a very oblique angle, and need not be sharply defined, or if defined, it is merely a sloping instead of vertical line.—ED.]

It is well to remember that the wing of a skewed abutment has to be lengthened only on the side making an acute angle with the line of track, since the other side merely has to coincide with the profile of the cone of the angle of repose of the bank.

If the bank of a stream is precipitous and formed of rock, a **U** abutment is economical, because the side or **U** walls can be stepped up and material saved, as shown at *L* in Fig. 12. But otherwise no economy results from the use of this form; and it is objectionable when put in under traffic, because the bank has to be removed parallel with the track and maintained at considerable expense and danger to trains, for the full length of these walls. Furthermore, unless these walls are carried at unnecessary expense further back than necessary to "catch the slope," the wash of high water is apt to undermine the latter. If the **U** walls are built wide enough for a double track and low in proportion, provision may be made for a second track, as shown at *L*, with but little expense by raising these walls later. It should be borne in mind that both **U** walls or wing walls have to be equal in length to the horizontal run of the slope of the bank; and that the former have to remain of full height, while the latter decrease at the ends to a height equal to two-thirds of their thickness there.

T abutments, it is submitted, although the most economical form known, should never be used except when the side slope (at right angles with the line of track) is so great that a great length of wall would be needed in any other form of abutment to cover the end of the bank, as shown at *M*, Fig. 13. In this case a great economy may result from the use of this form of masonry; but the **T** wall itself should not be built, as has been customary, with a section as at *N*, Fig. 13, but as at *O*, having cells filled with broken stone. The principal objection to this form may be thus avoided; but unless the **T** wall is carried farther back than required by the slope, the danger of wash is incurred; and the structure, if properly built, resolves itself into a **U** abutment with **U** walls close together and somewhat lightened on account of the doubtful value of cross walls. **T** and **U** abutments, if used at all, seem best adapted for deck spans of considerable depth.

Occasionally a case occurs, even when a closed culvert would be possible, and when the transverse slope of ground is so great that the culvert would have to be stepped, in which case a **T** abutment carrying girders would be economical and advisable.

A considerable "skew" and other local considerations often made it advisable to combine two different types, *e. g.*, one wing straight and one flaring, or one straight and stepped and the other a **U** wall.

In both **U** and **T** abutments it is thought that credit may be taken in proportioning the front wall on account of the value of **U** and **T** walls as counterforts.

It may be said, almost without limitation, that when abutments fail it is, in nine cases out of ten, due either to settlement of front of foundations or crushing of stone under truss bearings. The chances of the theoretical contingencies of sliding and bulging are but slight and the cause of the latter form of failure is generally that the masonry is held in place by the girder or bridge at the coping level, while the toe of the foundation has settled.

The failure of material is, of course, common. Observation of many cases has served to show that considerable economy can safely be effected in both piers and abutments, and especially the latter, by using wide-bedded, close-jointed, and coursed stone under bearings, and broken ashlar with wider joints and less cutting between bearings and in wing walls, where weight is the chief object in view and the duty of retaining earth pressure is the only one devolving upon the work.

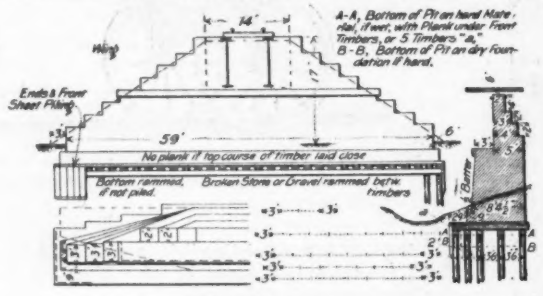

14'
Wing
A-A, Bottom of Pit on hard Material, if wet, with Plank under Front Timbers, or 5 Timbers "a."
B-B, Bottom of Pit on dry Foundation if hard.
Ends & Front Sheet Piling
59'
No plank if top course of timber laid close
Bottom rammed, if not piled.
Broken Stone or Gravel rammed betw. timbers
Batter
6'

Fig. 11.

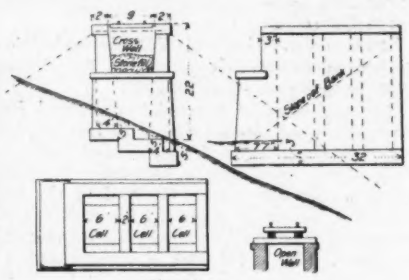


Fig. 13.

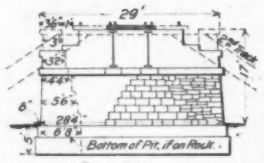


Fig. 14.

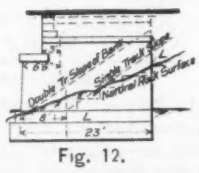


Fig. 12.

Fig. 15.

Fig. 16.

The failure of material in, of course, common. Observation of many cases has served to show that considerable economy can safely be effected in both piers and abutments, and especially the latter, by using wide-bedded, close-jointed, and coursed stone under bearings, and broken ashlar with wider joints and less cutting between bearings and in wing walls, where weight is the chief object in view and the duty of retaining earth pressure is the only one devolving upon the work.

If the highest class of masonry be used in these latter parts of the work, the failure will still be by crushing within the triangle defined by the bond as sustaining the weight of bridge and trains. Fig. 14 shows this and also the great importance of avoiding "bastard" stone (that is, stone laid with its "rift" vertical, or stone with vertical seams) in the part of the work bearing weight, since, by its use, all care used in preserving bond is neutralized.

It is worthy of note that in small open culverts and cattle guards, all stones should be thick and wide bedded, because the jar of trains is not distributed as in larger structures, and failure occurs soon if small stone is used, even with the best mortar.

Attention may also be called to the fact that irregularity and marked difference between the depth of headers and stretchers is very desirable, on structural as well as economical grounds, rather than a uniformly wide bed. In the latter case bond is lacking between the backing and the face stones, and a plane of weakness results throughout the entire height of the structure. Settlement or frost may cause the face stones to separate from the back and deprive the wall of its stability as a monolithic structure.

Cases of failure from this cause are not uncommon; and another not uncommon cause of failure is neglect to carry each "step" or change in thickness far enough up the wall. A safe rule is to carry these steps to a level above which the diminished thickness equals at least one-half the distance from surface of bank to top of step. Otherwise failure is liable to occur from overturning, each step being practically the foundation of an abutment of decreased width above it.

Any formula for thickness of an abutment is necessarily unsatisfactory, since whether solved by diagram or analytically, the question hinges so entirely on constants derived from the weight of the material and its angle of repose, and these characteristics vary so much in the same material when dry and wet, that the result of the calculation is after all, between wide limits, a matter of judgment. Four-tenths of the height is sufficient allowance for width in a general way, for sand or gravel filling, and six-tenths is sufficient for clay and quicksand, liable to become semi-fluid.

[By designing arch culverts for 129° instead of 180° (semi circular) arches, not only is the amount of arch work diminished one-third, but the abutments might be (though they should not be) made a little thinner, since the 120° arch gives a horizontal resultant to resist thrust, while the semi-circular arch does not. It is not very uncommon for small retaining walls or the side walls of box culvert to be slid bodily on their foundations by the pressure of carelessly made fills. The extreme care which is demanded in carrying a fill over a large arch is not necessary for a small arch, still a reasonable amount of care is necessary for all arches. Clay always demands especial and extreme care, and the more stable it appears when first cut the more caution is needed. In clayey cuts and fills the slopes may almost be said to never stand as first made, and the pressure thus exerted on masonry is often very great.—ED.]

It is sometimes possible, in building a line, or in substituting iron and stone for a trestle on a completed line, to economize largely and legitimately by merely building masonry enough to carry bridge girders or trusses, imbedded in the end of a fill, and this is particularly the case where there is no wash or where the fill is of rock, but in this case it would seem advisable to build the abutment of full thickness as if unsupported in front. See Fig. 15.

In replacing a trestle in the line of a rock or other solid embankment it is often found to be very economical to set a small pair of abutments in the slope of the bank, modifying the ordinary design of the span as shown in Fig. 16, in which *S* and *V* show alternative forms of truss. The material of the fill should be compacted by ramming for the abutments, which should be set at least 5 ft. from the slope of the bank, measuring at right angles. This avoids danger of overloading the slope or of displacement by frost.

[This is an excellent suggestion. The cheapest form for very high abutments, where the material used for the fill is safe against slipping, and where no great wash is to be feared, is nearly always to use two piers, one buried in the end of the fill, and the other at the toe of the end slope, connecting the two by an end span of about 1½ times the height of the fill. This is especially true when the fill is not likely to be made for many years, and will then be made by dumping from the trestle. The comparative economy of various designs of abutments (and of many other kinds of structures) can be most effectively studied by constructing a diagram, laying off height as abscissas and quantities or (better) costs at assumed rates per cubic yard as ordinates.—ED.]

Attention may also be called to the great advantage in leverage resulting from a projection of one or more footing courses of abutments as shown in the sketches, the same result being obtained by a projection of the transverse course of foundation timbers resting upon longitudinal timbers as shown in Fig. 11. The omission of this feature, although customary, lessens the value of a foundation very materially. It is thought that a full length coping, *i. e.*, with no side walls, such as are sometimes used with deck spans as shown in dotted lines, Fig. 11, is a preferable form because the bridge seats are left clear and not liable to collect snow and ice and refuse about the bearings, and the additional amount of coping is balanced by the saving in the amount of stone used. Also

that, in view of the certainty of a small amount of settlement in any foundation, it is well to set all masonry levels from a base of rail 1 in. to 2 in. above the actual base of rail.

[We are disposed to dissent from this, especially for small masonry structures. While masonry settles, embankments settle far more and far longer. It takes a year or two before the banks are so stable that there will not be more or less of a jolt upward at each structure a short time after surfacing. Set the masonry to grade and keep the approaches well up is the safer rule.—ED.]

Water Mains at River Crossings.

The March number of the *Journal of the New England Water-Works Association* contains a paper by Mr. E. H. GOWING, C. E., Boston, Mass., entitled, "An Experience in Crossing a Stream with a Main Pipe," from which, and the discussion of the same, we abstract the following:

Mr. GOWING was recently called upon to complete a system of water-works where an 8-in. main was to be carried across a stream 270 ft. wide at low, and 325 ft. at high water. The stream at low water had a maximum depth of 16 ft., and the maximum pressure in the pipe at this point was to be 85 lbs. The bottom of the stream was partly sandy and partly a ledge. The temperature at this locality sometimes goes as low as 30° below zero. At the time Mr. GOWING took up the work the plan was to carry the pipe across on a suspension bridge. Owing to the extreme coldness of the climate it was decided that a pipe on a bridge, no matter how carefully boxed, would give trouble through freezing, and, therefore, the pipe was laid on the bed of the stream, Ward's joints being used.

In the discussion which followed Mr. GOWING's brief paper, Mr. PHINEAS BALL, Worcester, cited examples of two 24-in. mains carried on a bridge across the Chicopee River at Springfield, Mass., in 1874, some 24-in. mains at New Haven, carried on a bridge across the Quinnipiac River, and an 8-in. pipe laid exposed in a rocky ravine near Greenfield, Mass., all of which were not boxed or in any way protected from freezing, but had not, to his knowledge, given trouble. The 24-in. mains were provided with expansion joints.

Mr. DEXTER BRACKETT, of Boston, gave an example of a 16-in. main supplying Everett, Mass., which was carried on timbers under the sidewalk of a bridge, and for seven or eight years gave no trouble, but finally froze solid. Mr. BRACKETT stated that the large pipes in connection with the Boston water works were unprotected, while the smaller ones were inclosed in a single or double box. Reliance is placed upon an air space rather than packing, especially since pipes generally leak a little, and the leakage will give less trouble when an air space is used instead of packing. There is an especial advantage in having a pipe where it can be examined, rather than beneath a stream.

Mr. H. G. HOLDEN, Nashua, N. H., said during the discussion that he had soon to lay an 8 in. pipe some 700 ft. long across the Merrimac River, and that he proposed to use a 12-in. box next the pipe and a 24-in. box outside that, the space between to be filled with tan bark. He considered tan bark better than sawdust, as it would never decay and was fully as cheap. He was thinking of using wrought-iron or steel pipe, and carrying the pipe on a highway bridge.

Useful Numbers for Ascertaining the Average Pressure of Steam in an Engine Cylinder with any Cut-off.

BY WM. COX.

In a former number (Jan. 3, 1891) we gave a number of equivalents or useful numbers for purposes of calculation and for slide-rule practice. In the present article we give a similar series for computing the average pressure of steam in lbs. per sq. in. for the whole stroke of a piston, when the initial pressure and the portion of the stroke at which the steam is cut off are known. They are based upon the formula

$$p = P\,\frac{1 + H}{R}$$

in which P= initial pressure in lbs. per sq. in., including atmosphere.

R = ratio of expansion.

H = hyperbolic logarithm of R,

and p = mean pressure during stroke in lbs. per sq. in., including atmosphere.

No allowance is made for imperfect vacuum. If, for instance, the steam is cut off at half stroke, we have from the table initial gage point 13, and average gage point 11, and for ordinary calculations we multiply the initial pressure by the average G. P. and divide the product by the initial G. P.; the quotient is the average pressure for the whole stroke, or

$$\text{Average pressure} = \frac{\text{initial pressure} \times \text{A. G. P.}}{\text{I. G. P.}}$$

For slide-rule practice, for which these gage points are specially suitable, as they all fall upon *marked* divisions of the rule and slide, and require, therefore, no estimation of the intervals of the one or the other, we place the initial G. P. for the given cut-off on scale C of the slide, so that it coincides with the average G. P. on scale D of the rule. We then have on the slide a series of initial pressures, and coinciding with the same, a series of average pressures on the rule, all corresponding with the given cut-off. The diagrammatical demonstration is as follows:

C	Set initial G. P. for given cut-off	Under initial press.
D	To aver. G. P. for given cut-off	Find average press.

Example: Given an initial pressure of 75 lbs. per sq. in., with the steam cut off at three-quarters of the stroke, what is the average pressure for the whole stroke?

$$\text{Average pressure} = \frac{75 \times 53}{55} = 72.27 \text{ lbs.}$$

On the slide rule,

C	Set 55	Under 75 lbs.
D	To 53	Find 72.27 lbs. average pressure.

TABLE.

Portion of stroke at which steam is cut off.	Initial G. P.	Average G. P.
7/8	250	248
3/4	55	53
5/8	37	34
1/2	13	11
3/8	31	23
1/4	57	34
1/8	65	25
7/8	200	199
3/4	139	136
5/8	139	132
1/2	167	151
3/8	214	164
1/4	30	152
1/8	46	24
7/8	100	33
3/4	68	67
5/8	80	75
1/2	10	7
3/8	43	20

NOTE.—These gage points are intended for the Mannheim slide rule, scale C on the slide and scale D on the rule, being both graduated alike.

Notes on Steam Car Heating.

At the last meeting of the Western Railway Club a paper was read by Prof. W. F. JOHNSON on Steam Heating of Trains. A large part of the progress thus far made in steam heating has been due to compulsory legislation. But little has been done in the West as yet because of the lack of compulsory legislation and the poverty of the roads.

The numerous steam car heating companies which two or three years ago were actively pushing their rival interests have been reduced by the survival of the fittest to three or four now doing an active business. Some of the car heating companies have given master mechanics to understand that trains could not be heated by steam without infringing fundamental patents. The writer believes, however, that there is nothing essentially patentable in the arrangement of steam pipes in the car, nor is any particular arrangement necessary to success, provided the pipes do not pocket water.

Experience has shown that about 1 sq. ft. of radiating surface to 25 cu. ft. of space to be heated is a sufficient amount. The ideal system, however, is the indirect, in which the car is heated by a hot water circulating system, which is warmed by steam from the locomotive. Experience here shows that 8 sq. ft. of steam heating surface is sufficient to warm a car by this system, the radiation from steam-heated pipe in contact with water being 20 times as fast as when in contact with air. One common defect with hot water circulating systems is the use of too small pipe. In general, 1¼-in. pipe is altogether too small for water circulating pipes in modern cars, and if the piping were done with 1½-in. pipe, the circulation would be so much freer as to make the same amount of radiating surface much more efficient.

The first Baker heaters used 20 years ago were in small cars, and only about 200 ft. of 1¼ in. pipe were used; but in the large sleepers now used there are 400 to 500 ft. of pipe. The length has been increased, but not the diameter, and as a result the circulation is often very slow.

Concerning couplings, the two that are now fighting for supremacy are the Gibbs and the Sewall. Each one of these is now largely used, and the question which coupler will eventually obtain supremacy is still undetermined. Any coupler to be steam tight, and at the same time couple easily and uncouple automatically, must be very perfectly made and must be well taken care of.

For disposing of the water of condensation a trap is the common reliance. Return systems have not been very successful. The great trouble is the leakage of air into the system at the couplings. There has been much less trouble with traps since the trainmen found out that they were not absolutely automatic and therefore gave them the needed attention.

The train pipe should be located inside the car so far as possible, to avoid the loss of heat by radiation, as well as danger from freezing. The author formerly favored the overhead train pipe, but does not now, on account of the difficulty of keeping couplings tight in this position and the great annoyance of leakage. The paper concluded as follows:

The question of the last three years has been whether it is practicable to heat cars by steam, but if we have a good coupling and a reliable steam trap, there is no reason why any road should not now adopt steam heating entirely, because there is no question as to its economy, not only in the use of coal, but in labor. A time has now come when the Western roads can take their choice of several systems, and be assured that they will get reasonable efficiency in the steam heating of trains. A further delay in this regard is not only to the sacrifice of human life, but a source of unnecessary loss in running expenses of the road.

In the discussion the defects of rubber hose were referred to. If made of very pure, soft rubber it will swell up and greatly reduce the bore of the hose; if of a harder rubber it is likely to crack. It was suggested that hose for steam heating should be lined on the inside with canvas or a wire coil to prevent the choking by the swelling of the rubber. The advantages of hot-water heating over direct steam were generally conceded, the only trouble being the difficulty in securing a good circulation with the hot-water system in some cases.

The Production of Bluestone in the States of New York, Pennsylvania and New Jersey.

For the above-named states Census Bulletin No. 71 shows a total of 5,126,340 cu. ft. of bluestone produced in 1890, of a value of $1,689,606. The expenditure for regularly organized quarries amounted to $608,582, of which $527,634 was for the wages of 1,793 persons employed in this industry.

This bluestone is one of the varieties of sandstone, and is made up of exceedingly small particles of silica cemented together by silica and a very slight amount of argillaceous material. This stone is exceedingly hard and durable, but is naturally difficult to work. Owing to its stratified nature, and to its hardness, it is well adapted for use as flagging and curbing, and it is chiefly devoted to this purpose.

Bluestone is not always blue, as its name would imply, for the color may vary from dark blue, or slate color, to bluish gray, and sometimes it is tinged with green or brown. The principal shipping points for the quarries in New York State are Kingston, Malden, Saugerties, Catskill and Coeymans, all on the Hudson River. Leading into Kingston are stone tramways, about 9 miles long, coming from the quarries at West Hurley and other points. The deeply laden wagons have worn ruts in the stone, which thus form a track from which the wheels cannot escape in the course of a trip.

Bluestone occurs in beds, with the surface layers quite thin, but increasing in thickness with the depth. In many cases powder is not used at all, as the stones can be easily removed with the simplest tools and methods. When the stones exceed 6 ins. in thickness it is split by plug holes and wedges.

The owner of the land is usually paid a royalty of from ½ to 1½ cts. per superficial foot on all stone ex-

tracted. Or, in some cases, a percentage of from 5 to 10% of the selling price is charged by the owner and paid by the shipping agent. The value of bluestone land varies greatly, depending on the amount and quality of the flagging. This land is usually useless for all agricultural purposes.

Floating Equipment on the Great Lakes.

Census Bulletin No. 66 states that the total number of vessels on the great lakes, on Dec. 31, 1889, was 2,784, with a total gross tonnage of 924,472, and total net tonnage of 780,119 tons. The estimated carrying capacity of these 2,784 vessels was 1,254,271 tons, and the commercial valuation was $48,808,750.

The following summary is given to show the class, average tonnage, average commercial value and commercial value per ton of the principal vessels:

Class of vessel.	Average tonnage.	Average commercial value.	Average commercial value per ton.
Propellers for freight and passengers...	469	$35,726	$76
Propellers for freight only..	894	53,857	60
Tugs.....	51	5,287	104
Schooners.....	198	4,506	23
Barges.....	468	11,507	25

The bulletin presents the statistical matter in two tables. One of these gives a statement of vessels by lakes, and the others a statement of vessels by ports on the lakes. In this first table the vessels are divided into 17 classes, and the number, gross and net tonnage, estimated carrying capacity and commercial value, etc., are stated. In the columns of percentages noted it appears that the total tonnage of steam propellers on Lake Superior carrying freight is only 13.517, or 34.09% of the total tonnage on that lake; and it also appears that the tonnage of steam propellers on this lake, carrying freight only, is but 3.49% of the total tonnage of such vessels on all the Great Lakes. The total value of steam propellers on Lake Superior, carrying freight only, is $808,500, or 32.51% of the total value of vessels on this lake; or 3.85% of vessels of this class on all the lakes. Similar percentages are given for all the lakes separately.

In summarizing the vessels by ports, it is seen that more than half of the vessels on the Great Lakes are assigned to the cities of Chicago, Port Huron, Detroit, Milwaukee, Grand Haven, Cleveland and Buffalo. This summary in full is as follows:

The New Croton Aqueduct Lawsuit.

The long threatened case of O'Brien & Clark vs. the City of New York for sums alleged to be due them for extra work, etc., on the new Croton Aqueduct, is now on trial before Judge INGRAHAM of the Supreme Court. The total claim was originally $732,312; but the ruling of this week, of Judge INGRAHAM, that the city was not responsible for any extra work done outside the contract, reduces the claim to about $300,000.

The complaint of the contracting firm is briefly about as follows: (1) That the value of material and labor supplied is $944,445.06; of which there is still due to them $217,189.23. (2) That all this work on Section 6 was done under the direction of the city's employés; and that all the work was supervised, directed, inspected and approved by the city. (3) That after the contract had provided for tunnel excavation, it was decided by the city's agent that all excavation not made necessary by faulty work or careless blasting should be paid for. The sum of $149,034.62 was yet due them under this provision. (4) That the city gave incorrect lines and levels requiring extra work to the amount of $150,000. Various smaller claims follow of under $10,000 each. A claim of $119,138 is made for false and misleading borings, shown to them by the city at the time of the letting; $125,000 is wanted for work done under "an alleged attempt to remedy defective work"; and delays occasioned by the city accepting and then rejecting brick are set down as worth $25,000.

The City answers that the work done and materials furnished by the contractors are worth only $748,852.97, and that $729,395.39 of this sum has been paid. All work done outside of this was incidental to the performance of the contract, and was not entitled to extra pay. The value of the tunnel excavation in the above stated $729,395.39 was $452,704.35. The City declares that all lines and levels given were true and accurate, and the change of plan at the Sawmill River—for which extra compensation is demanded—was made at the request of the contractors. As to misleading borings the City quotes the following extract from the contract and specifications:

"On account of the character of the work, which is mostly under ground the above-mentioned quantities cannot be estimated in advance with accuracy; therefore, bidders are required to submit their bids upon the following express conditions, which will apply to and become part of every bid, viz.:

"That bidders have satisfied themselves by personal examination of the location of the proposed work, and by such other means as they may elect, as to the accuracy of the foregoing estimates of the engineer; and that they will not at any time after the submission of a bid dispute or complain of such statement or estimate of the engineer, nor assert that there was any misunderstanding in regard to the nature or amount of work to be done."

The City explains that the boring of holes in the masonry and injection of grout were made necessary by the discovery that fraudulent work was being done, and this was the only safe and economical method of making this work good. In conclusion the City sets up a counter-claim against the contractors of $19,157.58 and $20,000 for failure to finish work within the specified and the extended time.

This trial is being continued, but as yet the evidence is not in shape to properly comment upon it.

Analyses of Well Water at Washington, D. C.

The following analyses of water and sewage were made by Mr. CLIFFORD RICHARDSON, Inspector of Asphalt and Cements, District of Columbia, and published in Mr. RICHARDSON'S report for the year ending Oct. 1, 1890:

(*Parts per million.*)

		Solid matter.	Ammonia. Free.	Ammonia. Alb'd	Nitrogen. Nitri.	Nitrogen. Nitra	Chlorine.
Mountain spring.....		19	.073	.015	.000	.3	4.5
Deep gravel well.....		174	.000	.020	.000	.0	4.0
Wash'ton aq.	best	80	.000	.060	.000	.4	4.0
	worst	274	.302	.652	Tr.	.8	5.0
River below city.....	best	104	.000	.242	.000	.8	4 0
	worst	144	.300	.204	Tr.	.5	4.5
City sewage..	best	248	1 448	2.84	.000	5.0	13.8
	worst	1096	43.0	8.30	.000	1.5	40.0
Washington wells.							
N. W.....	st'd.	278	.012	.064	Tr.	12.7	54.4
	bad	478	.429	.135	.069	20.0	91.1
N. E.....	st'd.	265	.028	.124	Tr.	24.0	31.8
	bad	523	.165	.163	.052	24.1	114.6
S. W.....	st'd.	566	.048	.048	.000	28.0	111.0
	bad	587	.239	.151	.059	18.8	114.4
S. E.....	st'd.	242	.015	.071	.000	12.1	60 2
	bad	659	514	.222	.017	34.2	113.6
County.....	st'd.	133	.020	.066	.000	4.1	18.5
	bad	165	.060	.123	.039	5.8	27.7

The object of the analyses was to show the condition of wells within the city of Washington and the District of Columbia drawn upon for water supply, and what, if any, should be ordered filled. Reference should, therefore, first be made to the lower part of the table. The analyses are thrown into five groups, four for different sections of the city and one for outlying portions. The first line of figures for each section indicates standard well water, which has been established as such by analyses made in previous years of water not subject to immediate contamination. The second line of figures gives analyses of bad water in each district. In the report named above it is stated, that of all the wells examined the water of 71% was either bad or suspicious, and that in the southeast section 40% and in the southwest section 100% of the wells examined had bad or suspicious water. During the year 17 wells were ordered filled and abandoned.

The report states that the only argument in favor of keeping the remaining wells open is the "filthy condition of the aqueduct water and the high temperature which it reaches in the mains in summer, often 85°."

The comparative quality of well water and of the best and worst water from the aqueduct is shown by the third and fourth lines of the table. It will be seen that the city or aqueduct water is, on the whole, far better than the well water, but in its worst stages it contains a large amount of solid matter, and compared with spring or deep gravel well water is very impure. It is interesting to compare all these analyses, thus far mentioned, with those of the best and worst city sewage given above.

The analyses are interesting, and show that the District Commissioners do well to keep a close watch over the supply from wells, and would probably do still better if they ordered many or all of the wells within the city filled and abandoned. To those who cannot afford ice the water in the hot months is, of course, very unpalatable, but the use of the wells would seem to be a continual menace to health, especially in case of an epidemic.

SUMMARY SHOWING NUMBER AND TONNAGE OF CERTAIN CLASSES OF VESSELS FOR CITIES NAMED.

CITIES.	TOTAL. No.	TOTAL. Tonnage	PROPELLERS CARRYING BOTH PASSENGERS AND FREIGHT. No.	PROPELLERS CARRYING BOTH PASSENGERS AND FREIGHT. Tonnage	PROPELLERS CARRYING FREIGHT ONLY. No.	PROPELLERS CARRYING FREIGHT ONLY. Tonnage	SCHOONERS. No.	SCHOONERS. Tonnage	BARGES. No.	BARGES. Tonnage	ALL OTHER CLASSES. No.	ALL OTHER CLASSES. Tonnage
Grand total...	2,784	924,472	307	143,983	433	387,095	939	185,776	301	138,404	804	69,214
Total	1,814	636,716	167	101,193	249	308,433	622	120,302	129	58,514	547	48,274
Chicago.....	339	71,200	34	13,181	28	10,960	155	35,859	18	6,245	104	5,005
Port Huron	293	61,148	11	1,857	73	40,840	100	6,302	21	6,797	88	5,656
Detroit.....	275	129 768	17	8,565	56	56,994	83	19,074	44	21,387	75	23,748
Milwaukee.....	239	61.694	12	3.282	53	39,172	129	15,034	6	2,246	59	3,960
Grand Haven.....	225	20,425	31	5,750	23	4.422	74	4,784	1	618	96	4,851
Cleveland...	219	163,227	19	33,995	66	83,979	61	30,373	19	12,302	51	2,087
Buffalo.....	204	128 869	43	34,542	50	72,066	17	10,376	20	8,909	74	2,967
Total other ports.....	970	287,756	140	42,790	84	78,662	317	65,474	172	79,890	257	20,940

Taking the totals only for the statement of floating equipment on the separate lakes, and including in this all classes of vessels, from the largest steam propellers to steam lighters and all manner of sailing vessels down to sloops, we have the following table:

LAKES, ETC.	No.	TONNAGE. Gross.	TONNAGE. Percentage of— Total tonnage on lake.	TONNAGE. Percentage of— Total tonnage of class named on all the lakes.	TONNAGE. Net.	TONNAGE. Estimated carrying capacity.	VALUATION. Commercial. $	VALUATION. Percentage of— Total valuation on lake.	VALUATION. Percentage of— Total valuation of class named on all the lakes.	VALUATION. Per ton gross. $
Superior.....	167	39,653	100.00	4.29	31,902	47,001	2,763,500	100.00	5.66	70.
Huron and St. Clair..	736	262,833	100.00	28.43	220 588	366,971	13,107,650	100.00	26.85	50.
Michigan.....	1,013	194,933	100.00	21.02	165,615	278,476	8.995.900	100.00	18.43	46.
Erie.....	664	39 ,557	100.00	42.46	332,722	517.731	22,131,600	100.00	45.34	56.
Ontario.....	131	15,830	100.00	1.72	13,699	23,272	676,300	100.00	1.39	43.
St. Lawrence River and L. Champlain	93	19,237	100.00	2.08	15,193	20,820	1,134,800	100.00	2.33	59.
Totals.....	2,784	924,472	100.00	100.00	780,119	1,254,271	48,809,750	100.00	100.00	54.

Legal Decisions of Interest to Engineers.

Liability of City for Change in Grade of Street.—A depreciation in the value of property abutting on a street resulting from a change of its grade by the municipality is not a taking of private property for public use, and hence, where the municipality acts under authority of law in changing the grade, and with due care, it is not liable for such depreciation, unless specially made so by statute. (Smith v. City of Eau Claire, Su. Ct. of Wis., 47 N. W. Rep., 830.)

Liability of Contractor on Public Work.—Defendant had a contract to construct a sewer in the street of a city, in which the city reserved the right to "vary, extend, or diminish the quantity of work during its progress." Before the work was completed he was directed to make certain changes in the grade of the sidewalk, which his workmen did in such fashion as to leave a hole near the curb, into which plaintiff fell, and was injured. He was an independent contractor as to his work, and is liable for the negligence of his workmen therein. (Charlock v. Freel, Ct. of Appeals of N. Y., 26 N. Y. Rep., 762.)

Basis of Damages in Condemnation.—In a proceeding by a railway company to condemn a right of way, the report of the commissioners having been set aside on exception by the land-owner, and the case having gone to trial without any pleadings on his part, he is entitled to full damages for the decreased value of the body of his land taken as a whole, and he is not confined to the government subdivisions described in the company's petition. The value of the entire tract, with the railway location across it, is to be estimated on the supposition that the company will erect and maintain fences and farm crossings as required by statute, and it is error to charge the jury not to consider any advantage arising from the erection of fences and farm crossings by the company. (Chicago, M. & St. P. Ry. Co. v. Baker, Sup. Ct. of Mo., 15 S. W. Rep., 64.)

Imposing Additional Obligations on Street Railway Company.—The fact that a street railway constructed its tracks under a franchise granted by a city does not exempt the company from the power reserved to the General Assembly by Code Iowa, Sec. 1090, of imposing any condition on the franchise of a corporation which it deems necessary for the public good; and hence, though the original franchise granted by the city required the company to pave only the space inside the rails, the obligation of the contract is not impaired within the meaning of the Federal Constitution by a subsequent ordinance passed by the city in pursuance of act, Iowa, March 15, 1884, requiring the company to pave in addition one foot outside of each of the rails. Affirming 78 Iowa, 367, 43 N. W. Rep., 224. (City of Sioux City v. Sioux City St. Ry. Co., Sup. Ct. of the U. S., 11 Sup. Ct. Rep., 226.)

THE PAINTING OF THE FORTH BRIDGE, say Messrs. Craig & Rose, of Glasgow, the contractors for this work, required 35,527 galls. of paint oils, and 250 tons of paint. During the construction of the bridge 980,072 galls. of machinery and illuminating oil were used.

ICE-COOLED CARS are being experimented with on some of the Indian railways. The ice is stored in the sides of the car and a current of air is made to pass over it and enter the car. On an experimental trip the temperature of the car interior was reduced to 80° Fahr., which is decidedly cool for Indian travel.

THE FAMOUS NAVARRO WATER METER is still on the market. At least, an attempt was made this week to sell at auction 9,700 of these "useful" machines, bought by New York City and paid for at the rate of $70 each, during the reign of Boss TWEED. They were offered at the upset price of $3.50 each. The first bid was $1.50 per ton; but finally 211 were sold at prices ranging from $3.60 to $4 each. The remaining 8,489 are yet on hand.

DYNAMITE AS A RAIN PRODUCER is to be officially tried, says a Washington news item, by the Agricultural Department. The scheme is credited to ex-Senator FARWELL, who, it is said, expects to accomplish marked results by exploding dynamite suspended in mid-air from balloons. The proposition is somewhat akin to the huge "electrical precipitator" scheme that some one once brought to our own office. This inventor was also going to use a balloon to hoist his "precipitator" to the moisture-bearing stratum of clouds and bring down rain at will.

THE TUBULAR FRAME WAGON CO., Mr. M. R. JEFFERDS, General Manager, has secured the Vulcan Steam & Forge Works, of Barrow, England, and will hereafter build its own cars. This is a company established in England for the building of American style freight cars with tubular frames.

THE TRIP FROM JAPAN TO ENGLAND, via the Canadian Pacific R. R., has been made in 25 days, including a three-days wait for a steamer at New York. The steamer Empress of India sailed from Yokohama to Vancouver, arriving April 28, in 10 days 14 hours and 34 minutes. The run of 2,900 miles to Montreal was made in 3 days 17 hours, with an average speed of 34 miles per hour. This new steamer has a trial speed record of 18.6 knots. She is 5,920 tons gross, 485 ft. long, and is driven by twin screws, with triple compound engines. The line has an English postoffice subsidy of $300,000 per year for carrying the mails for China and Japan. It is a monthly service, and from Quebec 30½ days in winter and 28½ days in summer are allowed. The penalty for failure to start at a fixed time is $2,500, and $500 for every whole day's delay, and $500 for every 12 hours' delay in arriving.

THE SIBERIAN RAILWAY is to be built by the Czar of Russia out of his private fortune, says a very dubious report from Moscow. The reason given is that the Czar has always warmly advocated this road, and as the present financial status of Russia will not permit the appropriation of the 350,000,000 roubles required, he has determined to carry on the work with his enormous private fortune. The same rumor says the Czar has 1,000,000,000 roubles (about $500,000,000) invested with London bankers on his private account.

THE LOCAL INDEBTEDNESS OF ENGLAND AND WALES is set down in *Herapath's Journal* as amounting to $999,000,000, showing an increase of 42.7% in the last 10 years. Of this sum about $445,000,000 are invested in water, gas and tramway companies and harbor improvements, and are productive, $265,000,000 are invested in general improvements and $165,000,000 in public buildings. About 200 municipalities now manufacture their own gas, and cities like Birmingham and Manchester reap a profit therefrom of $200,000 to $250,000 per annum. Public water supplies yield a surplus of $7,500,000 per annum above expenses. About $165,000,000 are yet invested in private gas undertakings; but the tendency is for the towns to buy up these works. *Herapath's* regards this "municipalization" of water, gas and tramway plants as a dangerous symptom, as shown in the rapid advance of the local debt. It is all well enough for times of peace and commercial prosperity; "but it would be a dangerous millstone in case of war or prolonged commercial depression."

THE COLUMBIAN WORLD'S FAIR directory points out the fact that the various states are making more liberal appropriations for the fair than they did for the Centennial of 1876. In the latter year 27 states appropriated $1,517,000; for 1893, 26 states have already appropriated $2,775,000, though the $1,000,000 for Illinois figured in the latter statement has not yet been officially set aside. The directory believes that the states will spend five or six times the amount upon the fair for 1893 that was appropriated for 1876.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Philadelphia & Seashore.—Construction is now in progress on the extension of this New Jersey railway to Sea Isle City. It is expected to have the line completed this month.

Adirondack & St. Lawrence.—The grading force along the line of this New York railway is being constantly increased, and work is making good progress. The engineers are locating the route in Franklin Co. It is probable that if the right of way through the state forest lands is secured a large force will be put at work at once, and the larger portion of the work completed this season.

Portland & Rumford Falls.—This company has given notice to the Maine State Railroad Commissioners that it will begin the location of the proposed extension of its line at once. Parker Spofford, of Bucksport, Me., is Chief Engineer.

Pennsylvania.—It is stated that a company will soon be formed to build a branch of this railway from Middletown to Hummelstown, Pa.

Little Falls & Dolgeville.—The grading on the first five mile section from Little Falls, N. Y., north is nearly finished.

Irondale, Bancroft & Ottawa.—This company is grading an extension from Irondale to Monmouth, Ont., 10 miles.

Lake Hopatcong, Boonton, Morristown, Caldwell & New York.—H. C. Reynolds, of Whippany, N. J., Secretary, writes as follows:

This road is projected to run from Montclair, N. J., on the New York & Greenwood Lake R. R., via Caldwell, Troy Hills and Parsippany, to Rockaway, N. J., 21 miles, with branches from Troy Hills to Morristown, N. J., and from Parsippany to Boonton, N. J., 9 miles long and 3 miles long respectively. To avoid the expense of constructing the tunnel near Montclair connections will be made for the present with the line recently completed from Great Notch to Caldwell. The work will be generally light; maximum grade 80 ft. per mile. There will be a bridge across the Passaic River. The surveys and profiles have been completed between Caldwell and Morristown, and surveys will soon be made for the remainder of the line. The principal business of the road will be the suburban freight and passenger traffic.

Central Counties.—A bill has been introduced into the Canadian Parliament providing for the following issue of bonds to provide for the construction of this road: $10,000 per mile secured upon the roadbed and all other property exclusive of rolling stock; $15,000 per mile upon the rolling stock and $600,000 of bridge bonds. The work is divided into sections as follows: From Hawkesbury to Glen Robertson, Ont.; the Caledonian Springs Branch, from South Indian to Rockland, from the Canada Atlantic Ry. to the St. Lawrence River, and the bridge and ferry across the Ottawa River. Work is now in progress on the section from Hawkesbury to Glen Robertson, 20 miles.

Projects and Surveys.

Chicago, Union City & Cincinnati.—Chartered in Indiana to build a railway from Union City, Ind., to Huntington, Ind., 70 miles. Among the directors are: F. A. Allison, J. C. Fawcett and Geo L. Danforth.

Eastern Ohio.—This company has been chartered in Ohio. The company will secure the franchises of the Cincinnati, Wheeling & New York R. R. Co., covering the right of way from Cumberland, O., to Cambridge, O., 15 miles. Among the incorporators are: J. C. Ryan, John B. McDonald and J. C. Steele.

Perry County R. R. Extension Co.—Chartered in Pennsylvania to build a railway from Bloomfield, Pa., to Landisburg and Loysville, Pa., 11 miles. Among the incorporators are: Chas. H. Smiley, President; Geo. Patterson, Landisburg, Pa.; R. H. Meoffit, Duncannon, Pa., and Wm. Miller, York. The company is probably chartered in the interest of the Perry County R. R. Co.

Syracuse & South Bay.—It is stated the proposed railway from Syracuse, N. Y., to South Bay, N. Y., on Oneida Lake, will be built this season. Chief Engineer, Walter F. Randall, Oneida, N. Y.

Moosilauke.—F. Conn, of Concord, N. H., Chief Engineer, writes us as follows:

The preliminary survey for this road, which is projected to run from Warren, N. H., northeast to the summit of Mt. Moosilauke, N. H., 20 miles, has been completed. The work will be light; maximum grade 4% and maximum curve 15°. It will be a friction road the entire distance. The principal business will be the summer tourist travel and the transportation of lumber. John H. Pearson, of Concord, N. H., is President.

Lehigh & Western.—Chartered in Pennsylvania to build a railway connecting the Lehigh Valley and the Wilkesbarre & Western railways between Berwick and White Haven, Pa. The line will be 35 miles long.

SOUTHERN.—Existing Roads.

Carolina, Knoxville & Western.—H. O Beattie has been appointed receiver of this South Carolina R. R.

South Florida.—A press dispatch states that McLean & Co. have the contract for building the proposed extension of this railway from Pemberton, Fla., north. It is expected that the 45-mile section between Pemberton and Dunnellon, Fla., will be under construction in a few weeks.

Wilmington, Onslow & East Carolina.—It is stated that grading will soon be resumed on the extension from Jacksonville to New Berne, N. C., 38 miles. A small amount of grading has already been done near Jacksonville and the work will begin at this point. F. L. Pitman, Wilmington, N. C., is Chief Engineer.

Bishopville.—The work on this railway from Bishopville, N. C., north is making good progress.

Mobile & Ohio.—The engineers have completed the survey for a railway between Columbus, Miss., and Tuscaloosa, Ala., and a favorable route is stated to have been secured.

Macon, Dublin & Savannah.—Tracklaying is now completed to within about 15 miles of Dublin, Ga. About 200 men are now at work on the line and it is hoped to have the road completed to Dublin by July 1.

Central R. R. of Georgia.—President E. P. Alexander, of this company, is quoted as follows:

It is our intention to build a line from Eliabel, on the Savannah & Western, to Oconee, Ga., on the main line, a distance of about 80 miles. This will shorten the distance between Savannah and Macon a out 30 miles. Part of this line has already been surveyed and graded, and is now ready for the rails. A survey will soon be made of the remainder of the line. This line is the shortest line that can be built from Savannah to Macon, and will not deviate from an air line 10 miles at any point. It will make the distance to Macon about 190 miles, instead of 192 as at present. After its completion it will naturally become the main line of the Central between Savannah and Macon. A short line to Atlanta could thus be built from Oconee to Milledgeville and from Eatonton to Atlanta.

Projects and Surveys.

Punta Rassa, Peace Creek & Alafia River.—A bill has been introduced into the Florida State Legislature incorporating a railway company by this name.

Northern Neck.—The people of Warsaw, Farnham and other towns in the Northern Neck of Virginia are agitating the construction of a railway from Fredericksburg, Va., southeast to Chesapeake Bay. The preliminary surveys will probably be commenced soon. E. D. Booker, Farnham, Va., is interested.

Baldwin County.—Chartered in Alabama to build a line of railway from Perdido Bay to Mobile Bay. Among

the incorporators are J. S. Leonard, of Pensacola, Fla., and Geo. P. Gates, of Muscogee, Fla.

Chesterfield & Kershaw.—A meeting of the stockholders will be held June 23 to organize this company. It proposes to build a railway from Cheraw to Camden, S. C.

Johnson City & Greensboro.—This company has been organized in Tennessee to build a line of railway from Allentown, Tenn., east to Patterson and Lenoir, N. C. The officers are: Frank A. Stratton, President, S. F. Harper, Vice-President; E. E. Davis, Secretary and Treasurer, and Henry E. Cotton, Chief Engineer.

Smithsonia & Danielsville.—This company has been organized to build a railway from Smithsonia to Danielsville, Ga., about 13 miles. The officers are: President Jas. M. Smith; Vice-President, Geo. C. Daniel; and Secretary and Treasurer, D. W. Meadow.

NORTHWEST.—Existing Roads.

Duluth & Winnipeg.—About 1,500 men and 250 teams are now at work on the line between Cloquet and Duluth, Minn., 16 miles. The work is being pushed, and it is expected to have the line completed by Aug. 1. It is stated that ties and rails are on hand sufficient to extend the line from its present terminus northwest 23 miles, and that work will be resumed soon.

Centralia & Chester.—The work on the extension from Coulterville, Ill., to Nashville, Ill., 15 miles, is making good progress. It is expected to have the track laid on this section some time in August.

Projects and Surveys.

Calumet & South Chicago.—Chartered in Illinois to build a railway from a point in Chicago to the Calumet Iron & Steel Works. Among the directors are H. A. Howard and D. W. Sullivan, of Chicago.

Merrill & Wausau.—A company is being formed to build a railway from Merrill to Wausau, Wis. The route will probably be over the old line of the Stevens Point & Northern R. R.

Duluth, Mesabie & Northern.—Chartered in Minnesota to build a railway from navigable water on Lake Superior to the northern boundary of the State of Minnesota. Among the incorporators are K. D. Chase, of Fairbault, Minn., and Jas. T. Hale and C. C. Merritt, of West Duluth, Minn.

Atic Akan.—W. W. Russell, of Port Arthur, Ont., has completed the survey for a railway from a point on the Canadian Pacific Ry., between Carlstadt and Bridge River, to the Atic Akan Iron Range, about 60 miles. A bill incorporating a company to build the line is now before the Canadian Parliament.

Yankton, Norfolk & Southwestern.—This company will soon award the contract for building its line from Yankton, S. Dak., to Bloomfield, Neb., about 25 miles. The general offices are at Yankton, S. Dak.

SOUTHWEST.—Existing Roads.

San Antonio & Aransas Pass.—It is stated that receivers' certificates to the amount of $350,000 will be issued to provide for the completion of the Waco branch of this road.

Louisiana, Arkansas & Missouri.—The preliminary survey for the line from Delhi to Bryan, La., 33 miles, has been completed.

Pine Bluff, Monroe & New Orleans.—This railway, running from English to Rob Roy, Ark., 30 miles, has been sold to L. H. Leslie, of Stuttgart, Ark., and F. M. Gillett, of 5 Wall St., New York City, who, it is stated, will extend it to a connection with the Stuttgart & Arkansas River R. R.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—The contract for tracklaying on the Seattle & Montana R. R. has been let to Shepard, Henry & Co. The material has arrived, and work is in progress.

Denver & Rio Grande.—It is stated as probable that the branch from Del Norte to Wagon Wheel Gap, Colo., which has not been operated for some years, will be opened up and extended to Cerede, Colo., 9 miles.

Southern Pacific.—An official of this road is quoted as saying that construction would begin on the coast line from San Luis Obispo to Ellwood, Cal., as soon as the preliminary arrangements are completed. The towns along the route are subscribing liberally in aid of the line.

Rio Grande Western.—Work on the extension of the Sevier R. R. from Manti, Utah, via Gunnison and Redwood, to Salina, Utah, is making good progress. About 300 men are at work on the grade, and the track has been laid to a point 5 miles south of Manti. The line has been surveyed from Salina south, via Richfield, Glenwood and Joseph, to Marysville, Utah. It is expected to have the road in operation to Sabina by July 1.

Projects and Surveys.

Denver & Irondale.—Chartered in Colorado to build a railway from Denver to Irondale, Colo. Among the incorporators are John N. Hubbard, Asa Baldwin and W. M. Ingersol. The principal offices will be at Denver.

Oregon, Washington & Idaho Ry. & Transportation Co.—Chartered in Washington to build railways and operate boat lines along the Columbia and Snake rivers. Among the incorporators are Chas. H. Dodd, W. P. Gray and W. H. Brewster.

Santa Fe, Prescott & Arizona.—Chartered to build a railway from Ash Fork to Phœnix, Ariz.

Seattle, Boise & Salt Lake.—The surveys for this road from Fayette, Idaho, to the headwaters of Bear Creek, 100 miles, have been completed. A favorable route is stated to have been secured.

FOREIGN.

Mexico.—A concession has been granted to Gen. Geronimo Treviño and Emeterio de la Garza for building the following lines of railway. From Venadito to Sierra Mojada and to a point on the Mexican Central Ry. in the State of Chihuahua; from a point on the Monterey & Mexican Gulf Ry., between the stations of Linares and Villagrau, to the mining districts San Carlos and San Nicolas, with the right to continue to Laguna Madre and to Soto la Marina, and from a point on the Monterey & Mexican Gulf Ry., between the stations of Cadereyta Jimenez and Monte Morelos, to a point on the Rio Grande River between Laredo and Guerrero.

Mexican Western.—This company has been chartered in Colorado to build a railway from Topalobampo, or Pacific City, Mexico, to Presidio de Rio Grande, Mexico. A. K. Owen, of Chester, Pa., is the chief promoter.

CITY TRANSIT.

Electric Railways.—New lines or extensions are reported as probable in the following places: Buffalo, N. Y., address the Buffalo Ry. Co. and the Crosstown Street Ry. Co.; Albina, Ore., address the Willamette Bridge Ry. Co.; Birmingham, Ala., address the Birmingham Railway & Electric Co.; South Denver, Colo., address the Denver Tramway Co.; Sioux City, Ia., address J. F. Peavey; Oakland, Cal., address E. P. Vandercook and E. Pollitz; Snohomish, Wash., address E. C. Ferguson, Frankfort, Ky.; New Albany, Ind., address J. Stotsenberg.

Bangor, Me.—A line to Old Town and Veazie is said to be proposed by the Bangor Electric Street Ry. Co.

Gloucester, Mass.—It is reported that the Gloucester street Ry. Co. will build an extension to Riversdale.

Johnstown, R. I.—The Town Council has given the Union R. R. Co. of Providence permission to build and operate a trolley line in the town.

Providence, R. I.—Bids for the construction of a 4¾-mile line are wanted by the Union R. R. Co.

Troy, N. Y.—The Common Council has granted a franchise to the Troy & New England Ry. Co. which requires two lines north of Poestenkill River, to be completed by Oct. 1, 1892, and the remainder of the road within the city limits by Oct. 1., 1893.

Williamsport, Pa.—The Westinghouse Electric & Manufacturing Co. will equip the railway here with 30 of its new gearless cars.

Beaver Falls, Pa.—The Beaver Valley Street Ry. is reported to have been purchased by the Central and Metamora Electric Street Ry. companies. It will be called the Beaver Falls Traction Co., and will be about 8 miles long when the extensions are completed.

Kanawha City, W. Va.—A company is being formed to build a line to Charleston. B. D. Avis will give particulars.

Canton, O.—A committee has been appointed by residents here to solicit from $20,000 to $30,000 for building the line to Massillon.

Abilene, Tex.—The North Park Improvement Co. will build a line 4 miles long, and is now prepared to let contracts.

San Francisco, Cal.—The York Beach & Mission R. R. Co. will, it is said, substitute electricity for horses on its lines.

Santa Cruz, Cal.—The Santa Cruz, Garfield Park & Capitola Electric Ry. Co. is reported as organized by local parties for the purpose of constructing and operating a three-mile road.

Tacoma, Wash.—The Puyallup Valley R. R. Co. has secured nearly all its right of way through the Puyallup Indian Reservation, and Manager Frank Ross reports that construction will probably begin in a few weeks.

Seattle, Wash.—J. K. Edmiston has petitioned for a franchise to construct and operate a line on several streets. G. C. Phinney is reported to have completed surveys for a double-track line to connect with the Seattle Electric R. R.

Elevated Railway.—*Philadelphia, Pa.*—The Law Committee of Councils has decided to favorably recommend the ordinance of the Northeastern Elevated R. R. Co. The company is to pay quarterly 1% of its gross receipts and cannot lease or sell its property without the city's consent. There is to be a clear headway of not less than 14 ft. at all places, and wherever the line crosses the tracks of any steam road there shall be a clearance of not less than 70 ft.

Dummy Railways.—Lines are reported to be under consideration at Newton, N. C., Bangor, Ala., and Madison, Ga.

Cable Railways.—*Baltimore, Md.*—The Baltimore Traction Co. proposes to operate its Gilmor & Carey St. line by cable.

Oakland, Cal.—The Consolidated Piedmont Cable Co. will change a portion of their horsecar line to a cable railway.

Horse Railways.—New lines or extensions are reported as probable in the following places: Pawtucket, R. I., address the Pawtucket Street Ry. Co.; Detroit, Mich., address A. E. Brush and W. Livingstone, Jr.; Stockton, Cal., address the Street R. R. Co.; Boulder City, Colo.; Little Rock, Ark., address the Pulaski Heights Land Co.; McRae, Ga.

Toronto, Ont.—Four tenders for the street railway franchise were recently opened and referred to the City Engineer, Solicitor and Treasurer. No action was taken on them up to the time of going to press.

Oakland, Cal.—The Board of Supervisors of Alameda County has given H. G. Blasdel a franchise for the portion of his proposed railway that lies outside the city limits.

New Companies.—East Side Ry. Co., Portland, Ore. capital stock, $25,000; incorporators, G. W. Brown, E. L. Long, A. W. Powers. Oakland, San Leandro & Haywards Electric R. R. Co., Oakland, Cal.; capital stock, $500,000; directors, H. W. Meek, W. J. Landers, E. B. and A. L. Stone. Norfolk & Suffolk Street Ry. Co., Boston, Mass.; capital stock, $100,000; President, J. W. Reinhart, of Brookline. Lakeside Ry. Co., Peoria, Ill.; President, C. S. Easton; Secretary, B. J. Greenhut. Leavenworth & Suburban Street Ry. Co., Leavenworth, Kan.; capital stock, $250,000; directors, G. A. Baker, W. Dill, G. Burrows and others. Springfield (O.) Electric Ry. Co.; capital stock, $50,000. Arcadia (Fla.) Street Railway & Improvement Co.; capital stock, $100,000; incorporators, A. Peters and H. Rogers, of Boston, Mass., and F. C. Peters, of Arcadia. Beaumont (Tex.) Street Ry. Co.; capital stock, $100,000; incorporators, F. P. Gague, of Houston; J. R. Ligon and B. W. McCarty, of Beaumont, and others. Bear Valley & Shamokin Street R. R. Co., Shamokin, Pa.; capital stock, $15,000; object, construction of a 2½-mile electric line.

HIGHWAYS.

New York.—The Highway Commissioners of Sodus have been petitioned to authorize a new highway. The Queens Co. Board of Supervisors has authorized the town of Jamaica to issue bonds for $400,000 for road improvements.

Pennsylvania.—The West Chester Board of Trade will raise funds for a telford pavement on the Paoli road. Springfield township proposes to issue $100,000 for road improvements.

Maryland.—The Baltimore Co. Commissioners have been petitioned to construct a road to Howard Co. A free turnpike is proposed from Mt. Airy to Ridgeville and Frederick.

Kentucky.—The Harlan & Bell Turnpike Co. has been organized at Pineville, Ky., to build a road to Harlan. President, J. B. Fish; Secretary, T. J. Asher.

Florida.—The senate has passed the road law, which repeals the present law, makes it a local option, and makes the county commission a legislative body to decide how the roads are to be worked.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*North Bath, N. H.*—The Concord & Montreal R. R. Co. will build a new bridge over the Ammonoosuc River at this place.

Mooresville, Ind.—The Commissioners of Morgan Co. have ordered the construction of a bridge over White Lick at this point. The structure is to cost $8,000.

Gordon, N. C.—A 125-ft. single span iron or combination bridge will be built across the Yadkin River at this place. Address the Winston Land & Improvement Co.

Murry's Mill, Ala.—The Limestone County Commissioners, Alabama, have decided to construct a bridge across the Elk River at this point.

Wichita Co., Tex.—Bids are asked until June 12 for a bridge across Big Wichita River. Address C. E. Reed, Wichita Falls, Tex.

Navasota, Tex.—Bids are asked until June 12 for a bridge across the Navasota River at this place. Address C. L. Kettler, Anderson, Tex.

Denver, Colo.—The plans for the Denver, Apex & Western Ry. are completed and bids will soon be asked for. The structure will cost about $100,000.

WATER-WORKS.

NEW ENGLAND.

Freeport, Me.—The contract which the people at a recent election authorized the town to make with E. B. Mallet, Jr., provides for a dam and reservoir on Frost's Gully Brook, a brick pumping station, a 1,000,000-gall. compound duplex and a 500,000-gall. direct-acting pumping engine and appurtenances, 25 × 60-ft. stand-pipe, 14,400 ft. of 10 to 4-in. cast-iron pipe and 18 hydrants. Works are to be completed by Dec. 1, if possible. Ilisley & Cummings are Designing Engineers.

Concord, N. H.—It is reported that the expenditure of $200,000 for water-works improvements has been voted by the city government. Percy M. Blake, Hyde Park, Mass., recently reported on improvements.

Goffstown, N. H.—The contract for furnishing and laying some 27,000 ft. of 24 to 4-in. pipe, and furnishing and setting hydrants, valves and specials, has been awarded to E. Gustine & Son, Keene, for about $20,000.

Lancaster, N. H.—The Lancaster Water Co. has elected G. R. Eaton temporary Secretary and appointed W. Clough, L. F. Moore and Burleigh Roberts as an Investigating Committee. Gravity works are projected. It is stated that negotiations are pending for the purchase of the works of Lancaster Aqueduct Co., built in 1871.

Whitefield, N. H.—The town has voted to establish a fire precinct, and proposes to spend $2,000 annually for water-works.

Adams, Mass.—It is reported that a pump will be added, water to be taken from a well.

Manchester, Mass.—Bids for laying about 12 miles of cast-iron pipe are wanted until June 17. No specifications will be mailed, but they may be had upon applying personally to Samuel Knight, Commissioner. P. M. Blake, Hyde Park, is Engineer.

West Boylston, Mass.—The Board of Trade is investigating the question of constructing works. J. C. Worcester is Secretary.

MIDDLE.

Amenia, N. Y.—Works are again projected.

Livingston Manor, N. Y.—It is reported that a company is building works.

Millerton, N. Y.—Works are under construction.

Schenectady, N. Y.—The Mayor has vetoed the $4,000 appropriation for an experimental well, and his veto has been sustained.

Tonawanda, N. Y.—The Village Trustees have passed resolutions complaining of the present supply furnished by the company and have appointed a committee to see what can be done to secure a better supply.

Westport, N. Y.—It is reported that works will be established.

Camden, N. J.—Joseph Wharton, of the Wharton Water Co., Philadelphia, has offered to supply water to the city at $20 per million galls.

Rutherford, N. J.—At a special meeting the people voted 218 to 3 in favor of a supply from artesian wells instead of from the Hackensack Water Co. The election may be declared illegal, as it was called by the Mayor, and the Council claims that he has no authority for such action.

Homestead, Pa.—The borough wishes bids until June 8 for works including a 2,500,000-gall. reservoir, a 2,000,000-gall. compound, condensing pumping engine, two 75-HP. tubular boilers, about 390 tons of 14 to 6-in. coated cast-iron pipe, 35 tons 18-in. flexible joint pipe, with specials, valves and hydrants, a pumping station and intake well. G. Schineller, 516 Market St., Pittsburg, is Enginner, and M. P. Schooley is Clerk of the Water Committee.

Wilkes-Barre, Pa.—The People's Water Co. has been incorporated; capital, $25,000.

SOUTHERN.

Wheeling, W. Va.—It is reported that $12,000 works will be built to supply Altenheim.

Atlanta, Ga.—The joint committee from the Water Commissioners and Council has voted not to accept the offer of the Chattahoochee Power & Water Co. to furnish a supply of water and has passed a resolution in favor of carrying out the plan of Rudolph Hering for a supply from the Chattahoochee River. The next step is for the Council to ratify the action of the committee.

Milledgeville, Ga.—It is reported that a franchise has been granted to Samuel Walker, and that he wishes bids for a 4-in. duplex pump to force water through 1,700 ft. of 4-in. pipe with a rise of 100 ft.; also bids for 2,000 ft. 4-in. pipe and specials.

Rome, Ga.—Paul Cooper, W. M. Towers and others have bought the Collier Springs, and propose to supply East Rome, and have offered to supply Rome. The plan includes pumps.

Key West, Fla.—A proposition to build works is before the Council. Works have been projected from time to time for several years.

Huntsville, Ala.—A new reservoir is projected.

Marion, Ala.—The Council has appointed a water-works investigating committee from its members.

Deptford, Tenn.—It is reported that the Deptford Land Co. will build works at once.

Lexington, Ky.—It is reported that at a recent meeting of the company the enlargement of the reservoir was favored, but that work cannot be started owing to difficulty in buying land.

NORTH CENTRAL.

Bridgeport, O.—The people have voted 333 to 22 for the issuance of $25,000 of bonds for works, the supply to be bought from Martin's Ferry.

Harrison, O.—Works have been completed by the Harrison Water, Light & Power Co., with the Heidenreich Co., Chicago, Contractors, and F. C. Horn, President of the water company, and Vice-President of the latter company as Consulting Engineer. Water is pumped.

Zanesville, O.—About $25,000 will be expended for pipe and pipe-laying, and the purchase of a pump is under consideration. The pipe will be bought directly, without asking for proposals.

Bay City, Mich.—Adams, Blodgett & Co., Boston, have bought $75,000 of Bay City water bonds.

Fowlerville, Mich.—The Senate has authorized the construction of $40,000 works.

Milford, Mich.—Works are talked of, outside parties having been investigating the matter.

Plymouth, Mich.—The Council has called a special village meeting to consider the bonding of the village for $20,000 for works.

Port Huron, Mich.—A 6-ft. tunnel beneath the Black River for water and gas mains is projected.

Belleville, Ill.—Oct. 15, 1890, the Council revoked the company's franchise, or annulled the contract, on account of an alleged failure in the supply. Recently a contract for fire hydrants was made for a year from April 30.

Pontiac, Ill.—The people voted to build works at their last election, and several propositions to do the work have been received.

Rockford, Ill.—An attempt is being made to secure legislation which will enable the city to raise money for an additional supply.

Roodhouse, Ill.—The Roodhouse *Eye* predicts that works will be built before the end of another year.

Sheridan, Ill.—A plan for works is advocated by Joseph Armstrong.

Ashland, Wis.—It is reported that the company's works have been sold to Boston parties represented by Wheeler & Parks, of that city, and that extensions will be made after the transfer has been completed.

NORTHWESTERN.

Carroll, Ia.—The Superintendent informs us that two miles of mains and a 750,000-gall. pump are being added.

Creston, Ia.—Fairbanks, Morse & Co., Chicago, have just received the contract for a large stand-pipe.

Dubuque, Ia.—The people of West End are petitioning for an extention of the works.

Garner, Ia.—C. S. Hall, Engineer, informs us that a windmill, tank, 2,000 ft. of 6-in. mains and 8 hydrants will be put in.

Wall Lake, Ia.—The Wall Lake Water-Works Co. has been incorporated; capital $6,000.

Northfield, Minn.—Surveys and estimates for works will be made by W. W. Curtis, St. Paul.

Tracey, Minn.—F. S. Brown, Recorder, informs us that on May 27 the people voted 7 to 1 in favor of works.

Worthington, Minn.—Bids will be received by the Council until June 10 for works, including supply wells, pumping station and plant and from 2 to 3 miles of mains with hydrants and specials. Harrison & Hawley, Drake Block, St. Paul, are Engineers and Frank Lewis is Town Recorder.

Wayne, Neb.—Plans for works estimated to cost $18,000 are being made by A. A. Richardson, Lincoln.

SOUTHWESTERN.

Aurora, Mo.—H. R. Hamilton, City Clerk, informs us that the people voted 40 to 1 in favor of works, and that the franchise has been granted to J. Guinney.

Helena, Ark.—J. O. Bagwell, City Clerk, has sent the following:

A franchise has just been granted Moffett, Hodgkins & Clarke, Syracuse, N. Y. There will be 6¼ miles of mains, 80 hydrants and a 1,000,000-gall. pump. If water is found within 500 ft. the supply will be from artesian wells; otherwise, from the Mississippi River.

PACIFIC.

Aberdeen, Wash.—Bids for $65,000 of water bonds are wanted until June 10. J. H. White is City Clerk.

Colfax, Wash.—A committee from the Council is investigating proposed works. A supply from springs by gravity is talked of.

Spokane, Wash.—The following is from D. B. Frotheringham, Mayor:

It is intended that the city be bonded for $500,000 for works. Plans for the supply of the south side of the river have been approved, and plans for an extension to the north side are being made. Construction will be started as soon as the bonds can be sold.

Los Gatos, Cal.—The Los Gatos Cold Water Co. has let a contract to John E. Saxton, Philadelphia, for the portion of the works aside from the distribution. This includes a dam and reservoir, tunnel 500 ft. long and a ditch.

Madera, Cal.—A franchise has been granted the Madera Flume & Trading Co., and 4 and 6 in. pipe is now on the ground. This pipe, it is said, will replace the 2-in. mains which now supply the town.

Pasadena, Cal.—The Pasadena Highland Water Co. has been incorporated; capital, $15,300.

Santa Ana, Cal.—Construction has been started.

CANADA.

Springhill, N. S.—Bids for works will be received by Daniel McLeod, Town Clerk, until June 15.

Winnipeg, Man.—Improvements are to be made by the company, including new mains.

ARTESIAN WELLS.

Charleston, S. C.—Z. Davis, Secretary, informs us that the Charleston Water-Works Co. has contracted with J. C. Miller & Co., Chicago, to sink a 2,000-ft. well for $44,000.

Marion, S. C.—Bonds for an artesian well are proposed.

Rome, Ga.—It is reported that L. J. Wagner, Superintendent of the city water-works, wishes bids for boring wells.

Belleville, Ill.—It is reported that the Water Company will sink a well.

Dyersville, Ia.—A well is talked of by some of the citizens.

Elgin, Tex.—An election will be held to vote on the sinking of a well.

Merlin, Tex.—The Council has contracted with the American Well & Prospecting Co., of Columbus, O., and Salina, Kan., to sink a well 8 ins. at the top, 6 at the bottom, and, if necessary, 2,000 ft. deep. Price, $5 per ft.

McKinney, Tex.—A well is wanted.

La Grande, Ore.—The La Grande Water Co. will sink a well, with J. W. Kerns, Trinidad, Cal., as Superintendent.

Lemoore, Cal.—It is reported that several wells will be sunk on the "lake land," about 20 miles southwest of this place. A. Paulsen recently sank a well on this land which flowed at 200 ft.

IRRIGATION.

Kearney, Neb.—W. H. Elliott informs us that surveys have been begun for a canal 40 miles long, with a water cross-section of 500 sq. ft. and a fall of 1 ft. in 5,000. Water will be brought out on the bluff north of Kearney.

McCook, Neb.—The precinct in which McCook is situated has voted bonds to aid in finishing the South Side canal, and work will be carried on rapidly.

North Yakima, Wash.—It is proposed to irrigate about 10,000 acres of desert land in the Moxee Valley, 6 to 12 miles from North Yakima, by water from artesian wells. Well-boring outfits have been received. A. H. Hiscock, Tacoma, Henry B. Scudder and F. B. Reed are said to be at the head of the company which has bought the land.

Beaumont, Cal.—An irrigation district is talked of.

Escondido, Cal.—The Pamo Water Co. has offered to build the necessary dams and flumes to supply the Escondido Irrigation District with water. J. M. Wood is connected with the company, and R. R. Beavers is one of the directors of the district.

Los Angeles, Cal.—The Briswalter Land & Water Co. has been incorporated; capital, $1,000,000; directors, G. J. Griffith, H. T. Hazard, and others.

SEWERAGE AND MUNICIPAL.

Sewers.—***Massachusetts.***—Pittsfield. An appropriation of $100,000 for sewers has been made. Bonds for $400,000 have been authorized.——Watertown. The sewer committee has made its report recommending 11.9 miles of sewers, 300 ft. to be of brick and the rest of pipe. The cost is estimated at $106,000.——Westborough. The Selectmen have laid out a sewer system. Action will be taken June 11.——Franklin. The Selectmen have submitted a plan for sewerage.——Holyoke. About 525 ft. of the Front St. sewer are to be rebuilt at a cost of $12,000.

New York.—Far Rockaway. The State Board of Health has refused to approve the plans of the Sewer Commissioners, which provide for emptying the sewage into Norton's Creek.——Suspension Bridge. The estimate of $20,323 for the sewer extension proposed by the engineer, Mr. W. C. Johnson, has been accepted.

New Jersey.—Orange, Bloomfield and Montclair are working for a joint sewerage system.——South Orange. The Woodruff farm is to be acquired for a sewage farm at an expense not exceeding $13,500.——Bridgeton. It is proposed to build a system of sewers at a cost of $60,000.

Pennsylvania.—Williamsport. Mr. Reeder, the City Engineer, estimates the cost of a complete system of sewerage at $400,000 It is proposed to spend $200,000 at once, and $20,000 per year for 10 years.

North Carolina.—Columbia. A stock company is to be organized to build pipe sewers. The City Engineer will lay out the system, and a franchise will be applied for.

Mississippi.—Vicksburg. The Lewis Mercer Construction Co., of New York, has applied for a franchise to build sewers. It has been suggested, however, that the city should advertise for proposals for construction.

Ohio.—Ironton. Plans for a system of sewerage are being prepared by Mr. Rudolph Hering.

Indiana.—Fort Wayne. Mr. Randall, City Engineer, has prepared plans for a sewer in the northwestern part of the city.

Illinois.—Elgin. It is proposed to spend $11,500 on sewers and $45,000 on paving.

Idaho.—Moscow. Plans are wanted from engineers for a system of sewers.

Texas.—Austin. Mr. W. B. Brush states that his sewer system is in condition for connections on annual rental. He has a 99-years franchise from the city and wants to sell out.

Streets.—***New York.***—Greenbush. The trustees have awarded a contract for granite block paving to Mr. Dumary.—Buffalo. Brick paving on a 6-in concrete foundation is to be laid on Purdy St.

Washington.—Olympia. Main St. is to be macadamized, and have stone gutters and wooden curbs.

Bonds.—Monongahela City, Pa.; $25,000 for sewers and streets. Grand Forks, N. Dak.; $50,000 for sewers. Bradford, Mass.; $10,000 for sewer; bids received by the Selectmen until June 9. Redwood City, Cal.; $45,000 for sewers and electric light. St. Henri, Que.; $50,000 for streets. Menominee, Mich.; $100,000 for streets and sewers. Moscow, Idaho; $80,000 for sewers, streets, etc. Gloucester, Mass.; $50,000 for streets. Oakland, Cal.; $30,000 for boulevard.

ELECTRICAL.

Electric Light.—New plants or extensions are reported as probable at the following places: Amboy, Ill.; Milford, Del., address N. Pratt; Platteville, Wis.; Shushan, N. Y.; Great Falls, Mont., address W. J. Winters; Kinderhook, N. Y.; Lafayette, La.; Sharon, O.; Fond du Lac, Wis.; Georgetown, Ky., address J. W. Whittle; Gainesville, Ga.; South Boston, Va., address the Barbour Buggy Co.; Morganfield, Ky., address C. Waller; Gal-

latin, Tenn., address H. Holderman; Carrollton, Ga., address the Carrollton Light & Power Co.

Wheeling, W. Va.—The Council Committee on Ordinances has recommended to the City Council that the question of issuing $80,000 of bonds for building an electric light plant be decided by a public vote.

St. Clairsville, O.—It was voted June 1 to issue $10,000 of bonds for an electric light plant.

Cincinnati, O.—The Committee on Light of the Board of Legislation has under consideration specifications for lighting the city with electricity. The contract is to be for 5 years; the lights are to be of 2,000 c. p., from 600 to 800 ft. apart, and to burn 3,760 hours per year.

Paris, Tex.—It is reported that the city will install a $20,000 electric light plant.

Electric Power.—*Reading, Pa.*—It is stated that it is proposed to purchase the water rights at Shepp's Dam near this city, and establish a plant for furnishing power.

New Companies.—Hastings (Mich.) Electric Light & Power Co.; capital stock, $15,000. Portland (Mich.) Electric Light & Power Co.; capital stock, $10,000. Chillicothe (Ill.) Water, Electric Light & Power Co.; capital stock, $30,000; incorporators, S. B. Hartz, G. H. Lucas, E. W. Wilson. Clinton (Ind.) Electric Light & Power Co.; capital stock, $10,000; directors, B. H. Morgan, W. H. Bonner, D. McBeth and others.

CONTRACTING.

Sewers.—*Port Jervis, N. Y.*—The following proposals were received by the Sewer Commissioners May 29, and the contract was awarded to Van Vranken & Duell, of Schenectady, N. Y. Mr. Wm. B. Landreth is Chief Engineer:

Sewers.—*Baltimore, Md.*—The following proposals for sewer materials have been received: Cobblestones: John Curley, $2.25 per cu. yd.; Bergeman & Peddicord, $2; B. Kepner, $2.50; John Harris, $2.30. Cement: C. C. McColgan, U. Co. brand, $1.25 per bbl.; Rosendale, $1.05 per bag. Bricks: G. W. Robinson & Co., $8.50 or $7.45 per 1,000 for hand or machine made; D. Donnelly, $7.50 for either make; Klein Bros., $8.20 for hand made. Sewer blocks: Albert Weber, $100 per 1,000, $2.45 per sq. yd.; Guilford & Waltersville Granite Co., $105, $2.50.

Pipe.—*Toronto, Ont.*—The Water-Works Department has awarded the contract for cast-iron pipe to the St. Lawrence Foundry at $35 per ton for 12-in., $35.30 for 6-in., and $35.80 for 4-in.

PROPOSALS OPEN.

Sewers.—*Vicksburg, Miss.*—Plans and specifications on file. R. V. Booth, Mayor. July 6.

Maywood, Ill.—Outfall sewer, 1,823 ft. of 18-in. brick, 332 ft. of 18-in. brick, 332 ft. of 15-in., 1,087 ft. of 12-in., 6,234 ft. of 9-in., 4,141 ft. of 8-in., 3,267 ft. of 6-in., 150 catch basins, etc. Plans and specifications with C. W. Maynard, 84 La Salle St., Chicago. P. J. Jeneson, Village Clerk. June 24.

Fort Brady, Mich.—Capt. G. S. Hoyt, U. S. Quartermaster's Office, Sault Ste. Marie, Mich. June 23.

Water-Works.—*Manchester, Mass.*—Laying 12 miles of cast-iron pipe. Engineer, P. M. Blake. S. Knight, Board of Water Commissioners. June 17.

Worthington, Minn.—Pumping plant of 750,000 galls. capacity, brick pump-house, well system, 2 to 3 miles of pipe and fittings. Engineers, Harrison & Hawley, Drake Block, St. Paul. Frank Lewis, Recorder. June 10.

"hundreds" for "thousand," etc. By this change to the metric system there is much less liability of error in the reading, especially when this is made by one not fully conversant with the usual practice. An inspection of an old style register will show that a correct indication of 65,432 cu. ft., for example, may be read 654,320 cu. ft. With the metric notation the only error possible is in the decimal dial, an error amounting to nothing. The company is now seeking a vote upon the comparative merits of the two devices from those interested in meters.

The Jos. Dixon Crucible Co., of Jersey City, N. J., states that its graphite grease is used as a lubricant for elevators and on the wire cables and guides of elevators.

The Berlin Iron Bridge Co., of East Berlin, Conn., has an order from the Companhia Nacional de Tecjas e Estaleiros, of Rio de Janeiro, Brazil, for an iron building 300 × 165 ft. for its shipbuilding plant. J. A. Fay & Co., of Cincinnati, O., have the order for machinery.

The F. J. P. Brackett Bridge Co., of Cincinnati, O., has completed an inclined plane 1,500 ft. long at Elm St. for the Cincinnati Consolidated St. Ry. Co., and is erecting 2 bridges of 175 ft. span for the Middletown & Cincinnati R. R. and several highway bridges 46 to 110 ft. long.

Coolbaugh, McMunn & Pomeroy, of New York, N. Y., agents for Carnegie, Phipps & Co., Boies Steel Wheel Co. and Martin Anti-Fire Car Heater Co, have removed to the Columbia Building, 29 Broadway.

The Consolidated Car Heating Co., of Albany, N. Y., has elected the following officers: President, R. G. Pruyn; Vice-President and Treasurer, W. G. Rice; Secretary, C. J. Peabody; General Manager, D. D. Sewall; Assistant General Manager, J. H. Sewall; Mechanical Superintendent, J. T. McElroy; Executive Committee, R. G. Pruyn, W. G. Rice, Geo. Westinghouse, Jr.; D. D. Sewall, J. T. McElroy and A. S. Hatch.

	Sewer pipe.						Drain tile.			Cast iron.			Manholes, 20.	Lampholes, 224.	Flush tanks, 50.	Lumber, 20 M.	Concrete, 200 yds.	Total.
	18-in., 3,000 ft.	15-in., 850 ft.	12-in., 750 ft.	10-in., 4,840 ft.	8-in., 18,880 ft.	6-in., 32,155 ft.	8-in., 2,400 ft.	6 in., 4,000 ft.	4-in., 2,000 ft.	18-in., 250 ft.	10-in., 100 ft.	8-in., 300 ft.						
	$	$	$	$	Cts.	Cts.	Cts.	Cts.	Cts.	$	$	$	$	$	$	$	$	$
Van Vranken & Duell, Schenectady..	1.24	1.02	.85	.80	71	57.5	4	4	4	10.00	2.00	1.50	35	5.00	50	16.00	4.00	62,517
M. Sullivan, Little Falls, N. Y.....	2.33	1.00	.90	.85	78	51	20	15	10	9.00	4.00	3.00	50	2.00	60	16.00	4.00	65,258
Adam Miller, Saratoga, N. Y.....	1.87	1.20	1 00	1.13	70	58	19	11	8	12.50	1.66	1.45	40	8.25	60	20.00	5.00	67,874
P. T. Plunkett, Passaic, N. J.....	1.73	1.50	1.25	.89	73	63	38	35	30	3.50	2.00	1.50	35	2.00	80	25.00	3.00	70,450
Troy Public Works Co., Troy, N. Y...	2.13	1.54	1 32	1.23	97	50	20	15	10	3.16	1.76	1.25	40	9.00	65	18.00	5.00	70,778
Fogg & Scribner, New York, N. Y....	2.00	1.20	1.00	1.00	70	58	25	20	20	12.00	6.50	5.50	50	15.00	80	28.00	6.50	75,102
Smith & Minahan, Easton, Pa.....	1.40	1.25	1.20	.95	90	70	10	10	10	8.00	3.00	2.50	33	10.00	50	20.00	4.00	75,9 0
Jas. H. Edwards, New York, N. Y....	2.65	1.70	1.15	1.10	80	51	20	17	15	15.00	5.00	3.50	55	12.00	70	25.00	6.00	76,180
John Maraden, Utica, N. Y.....	1.75	1.15	1 00	1.25	90	65	18	15	12	10.00	2.00	1.50	48	15.00	58	15.00	5.00	78,401
Chas A Rooney, Paterson, N. J.....	2.00	1.75	1.25	1.25	80	70	80	50	40	7.00	7.00	6.00	30	20.00	80	16.00	4.00	88,766
Frank Rinschler, Stapleton, N. Y....	1.61	1 415	1.205	1.10	100	90	21	14	10	4.90	3 50	2.80	42	6.00	90	22.50	6.00	91,489

Dredging.—The following proposals have been received by Col. P. C. Haines, U. S. Engineer Office, Washington, D. C.: For 400,000 cu. yds. in Virginia channel of Potomac River, J. H. McKee, Washington, 16 cts. per cu. yd., in place; Alabama Dredging & Jetty Co., Mobile, Ala., 16 cts. For 100,000 cu. yds. in Virginia channel: T. C. Somers, Camden, N. J., 9.9 cts. per cu. yd., scow measure; Alabama Dredging & Jetty Co., 11 cts. For 100,000 cu. yds. in Eastern branch: T. C. Somers, 17.9 cts. per cu. yd., scow measure.

The Harbor Commissioners of Montreal, Que., have awarded the contract for dredging the harbor from 24 to 26 ft. deep to Larkin, Connolly & Co., at 35 cts. per cu. yd.

The following proposals have been received at the U. S. Surveyor's office, Wilmington, Del. *A*, Atlas Dredging Co., Wilmington, Del.; *B*, National Dredging Co., Wilmington, Del.; *C*, F. C. Erners, Camden, N. J.; *D*, C. D. Caler, Norfolk, Va.

	A	*B*	*C*	*D*
	Cts.	Cts.	Cts.	Cts.
Wicomico River, Md....	20	25	12	14¾
Choptank River, Md.....	24	..	20	14½
Chester River, Md.....	20	10	20	....
Onacock Harbor, Va.....	..	..	18.9	19½

Piers.—The contract for ice piers in the Ohio River at Portsmouth, Ripley and Herr's Run, O., has been awarded by Lt. Col. W. E. Merrill, U. S. Engineer Office, Cincinnati, O., to J. R. Ware, of Cincinnati. Rip-rap stone, 80, 74 and 85 cts. per cu. yd. respectively; oak timber, $19.50 per 1,000 ft. B. M; drift bolts, 7 cts. per lb.; mooring rings, 9 cts. per lb.

Street Work.—*Chelsea, Mass.*—The work of granite paving will be done by the city, by the day, at a cost of $2.45 per sq. yd. The highest bid received was $3.82.

Taunton, Mass.—The contract for granite block paving and 18-in. deep curbing has been awarded to Kenneth McKay, of Valley Falls, R. I., for furnishing and setting the material, the city doing the excavating: paving, $1.75 per sq. yd.; curbing, 65 cts. per ft. for straight and 95 cts. per ft. for curves. Mr. Luther Dean is the Engineer.

Boston, Mass.—The following proposals for graveling Congress St., South Boston flats, have been received by the Harbor and Land Commissioners: Eastern Grading Co., 73 cts. per cu. yd. (or 63 cts. if time is extended to Oct. 31, 1892); Thos. Cargill, 75 cts.; Geo. W. Keyes, 79 cts.; T. F. Mavey & Co., 99 cts.

Bowling Green, Ky.—Contracts have been awarded to the Bowling Green Quarry Co. at 60 cts. per sq. yd. for paving, 85 cts. per ft. for crossings, 45 cts. per lin. ft. for curbing, $1.50 and $2 for corner stones 24 and 18 ins. radius.

Fort Brady, Mich.—Capt. G. S. Hoyt, U. S. Quartermaster's Office, Sault Ste. Marie, Mich. June 23.

Brush and Poles.—*Memphis, Tenn.*—About 57,000 cords brush, 11,000 cords poles, 40,000 cu. yds. stone, 312,000 lbs. wire strand, 415,000 lbs. wire, 18,000 ft. wire cable, 26,000 lbs. spikes, 4,000 lbs. clevises, 4,200 lbs. staples, 22,000 lbs. rope. Capt. C. McD. Townsend, U. S. Engineer Office. June 10.

Memphis Tenn.—About 35,000 cords brush, 7,000 cords poles. Capt. S. W. Roessler, U. S. Engineer Office. June 13.

Pier and Breakwater—*Chicago, Ill.*—D. H. Burnham, Chief of Construction, World's Columbian Exposition, 1143 Rookery. June 10.

Asphalt Pavement—*Washington, D. C.*—About 2,300 sq. yds. of pavement, 2,700 sq. yds. of walk, 700 sq. yds. of repairs. Col. O. H. Ernst, Office of Public Buildings and Grounds. June 25.

Street Work.—*Lenox, Mass.*—Telford paving 12 ins. deep, 20 to 30 ft. wide, excavation, cobblestone gutters, 4 in. drain pipe, etc. Engineer, W. S. Bacot, 145 Broadway, New York City; Geo. W. Folsom, Superintendent of Streets. June 13.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., have built 2 engines for the Maine Central, and has orders for engines for the new Adirondack & St. Lawrence. The Rogers Locomotive Works, of Paterson, N. J., have built an eight-wheel and a Forney engine for the New York & Northern.

Cars.—The Gilbert Car Co., of West Troy, N. Y., has built 14 passenger cars 70 ft. long for the New York & Northern. The Harris Palace Car Co. will build 5 cars. The Haskell & Barker Car Works, of Michigan City, Ind., have an order for 500 box cars for the Lake Erie & Western. The Youngstown Car Co., of Youngstown, O., is building 500 gondola cars for the Pittsburg & Lake Erie. The Pullman Palace Car Co., of Chicago, Ill., has built 8 palace cars for the Denver & Rio Grande, 40 passenger cars for the Baltimore & Ohio and 3,000 coal cars for the Philadelphia & Reading.

Car Lighting.—A Pintsch gas plant is being erected at Savannah, Ga, with a capacity for supplying 700 cars per day. The plant will cost $12,000 and be completed next month.

A New Water-Meter Dial has been made by the Thomson Meter Co., of New York. The change suggested is solely in the names given to the separate dial plates; thus "units" for "ten;" "tens" for hundred;"

Companies.—Municipal Construction Co., of Peoria, Ill.; J. F. King, S. H. Lucas, W. L. Prettyman; $100,000. Kansas & Texas Construction Co., of Chicago, Ill.; H. A. Christy, E. E. Wise, J. K. Duckworth; $500,000. San Francisco Drydock Co., of San Francisco, Cal.; J. E. Simpson, Jr., of Brooklyn, N. Y.; J. E. Howard, of Oakland, and C. L. Taylor, of San Francisco; $1,000,000. Southwestern Steel Post Co., of East St. Louis, Ill.; A. B. Bennett, H. Pope, W. P. Clarkson; $500,000. German-American Land Improvement, Irrigation & Mining Co., of Chicago, Ill.; L. W. Young, S. Victor and B. G. Kramer; $1,000,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $20.50 for iron and $17 for steel. Pittsburg: $30; old rails, $23 to $23.50 for iron and $17.50 to $18 for steel. Chicago: $31; old rails, $22.75 for iron and $14.50 to $17 for steel.

Track Materials.—New York: steel angle bars, 1.7 to 1.75 cts.; spikes, $1.9 to $1.95; track bolts, 2.60 to 2.65 cts. with square, and 2.75 cts. with hexagon nuts. Pittsburg: splice bars, 1.8 to 1.9 cts. for iron or steel; iron or steel spikes, 2.05 cts.; iron track bolts, 2.75 cts. with square, and 2.85 cts. with hexagon nuts. Chicago: splice bars, 1.85 to 1.9 cts. for iron, 2 to 2.05 for steel; spikes, 2 to 2.1 cts.; track bolts, 2.8 to 2.9 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $16. Pittsburg: $14.50 to $17. Chicago: $14.50 to $16.

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 55 and 45 per cent. on black and galvanized butt-welded; 65 and 52½ on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.45 to 4.5 cts. St. Louis: 4.15 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.95 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 2 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.65 cts.; universal iron mill plates, 2.1 cts.; sheared steel bridge plates, 2.1 to 2.15 cts.; refined bars, 1.8 to 1.9 cts.; steel plates, 2.1 cts. for tank, 2.45 cts. for shell, 2.7 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.25 to 2.3 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.3 to 2.4 cts.; sheared plates, 2.5 to 2. cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.6 to 2.7 cts. for tank, 3.25 cts. for shell, 3.5 cts. for flange, 4.25 to 5.5 cts. for firebox; boiler rivets, 4 to 4.25 cts.

To Contractors.

NOTICE IS HEREBY GIVEN THAT THE Superintendent of Streets of the Town of Lenox, Mass., will receive sealed proposals until Thursday, June 11, at 12 o'clock noon, for improving with Telford pavement certain streets in the Village of Lenox in accordance with the plans, profiles and specifications for the same prepared by William S. Bacot, Ch. Engineer, on file at his office, 145 Broadway, New York, and also at the office of said Superintendent of Streets, Lenox, Mass., where the same may be examined by contractors.

The engineer's estimate of the amount of work to be done is approximately as follows:

Twelve (12) in. Telford pavement:
Twenty (20) ft. wide, 5,400 sq. yds.
Twenty-four (24) ft. wide, 2,200 sq. yds.
Thirty (30) ft. wide, 5,250 sq. yds.
Approaches, 2,150 sq. yds.
Excavation, 5,000 cu. yds.
Cobblestone gutters, 2,500 sq. yds.
Four (4)-in. (land tile) drain pipe, 3,000 lin. ft.

The stone for the Telford foundation shall be rock quarried in or near the Village of Lenox in all respects equal to the sample in the office of the engineer, or other equally hard stone.

The stone for the broken-stone surface courses shall be stone obtained from the vicinity of Lenox in all respects equal to the sample in the office of the engineer, or stone equally good for the purpose.

A twelve (12)-ton steam roller, with engineer and fuel, will be furnished by the Superintendent of Streets free of all charge to contractor.

Time allowed for completion of the contract is sixty (60) working days.

Two sureties will be required, each in Twenty-five (25) per cent. of the total contract price for the work.

The said Superintendent of Streets reserves the right to reject any or all bids.

GEORGE W. FOLSOM,
Superintendent of Streets,
Town of Lenox, Mass.

Dated May 27, 1891. 23-1t

SPRINGFIELD, O., WATER-WORKS.

SEALED PROPOSALS will be received by the Trustees of Water-Works, Springfield, Ohio, at their office in the City Building, until eight o'clock P. M. of June 15, 1891, for furnishing approximately 200 tons of cast-iron pipe as follows:

20 tons of 3-inch, weighing 15 pounds per foot
20 " " 4 " " 22 " " "
65 " " 6 " " 33 " " "
15 " " 8 " " 42 " " "
75 " " 10 " " 60 " " "
5 " " special castings for same.

Delivery to commence within 10 days after signing of contract, and to be completed by October 1, 1891. The trustees reserve the right to alter the proportions required of the different sizes, as circumstances may dictate, the total tonnage remaining the same. All pipe and specials must have the usual coating, and all prices include the delivery "f. o. b." Springfield, Ohio.

The trustees reserve the right to reject any and all bids for any reasons.

(Signed) E. C. GWYN, C. NAGEL, } Water-Works Trustees.

SPRINGFIELD, O., May 30, 1891. 22-2t

To Water-Works Contractors.

—Proposals for laying about twelve miles of cast-iron water pipes will be received by the Town of Manchester, Mass., until Wednesday noon, June 17, 1891. The requirements are rigorous, and no bid will be entertained from contractors who have not laid under direct contract at least twenty- miles of cast-iron pipes. Printed specifications can be obtained of Samuel Knight, Manchester, Mass., on personal application. No specifications will be mailed. Bidders must visit the town in person. The right to reject any or all bids is reserved by the Town.

SAMUEL KNIGHT,
ROLAND C. LINCOLN,
WILLIAM HOARE,
Board of Water Commissioners.
PERCY M. BLAKE, Engineer.

MANCHESTER, Mass., June 1, 1891. 23-1t

Notice to Contractors.—Sealed

proposals for the graduation, preparation of foundation and paving with brick a part of several of the streets of this city will be received by the Common Council of the City of Huntington, West Va., until 8 o'clock P. M., Monday, June 15, 1891, also until said time by the same will be received bids for furnishing curbing and setting the necessary curbstone for said improvements.

Complete specifications for each improvement can be seen on file at the office of G. H. Myers, City Clerk. The right is reserved to reject any and all proposals.

Proposals to be addressed to G. H. Myers, City Clerk, marked (paving or curbing) bids. Form of bids will be furnished by City Clerk.

C. A. BOXLEY,
Chairman Street Commissioners.
J. L. THORNBURG,
City Engineer.

23-3t

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.
Also Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc.
CHAS. MILLAR & SON, Selling Agts., Utica, N. Y
Manufacturers of Lead Pipe and Plumbers' Materials.
Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

MONTAGUE & CO.,
MANUFACTURERS
FIRE BRICK, SEWER PIPE,
DOUBLE STRENGTH
RAILROAD CULVERT PIPE,
With long sockets, in two and one-half foot lengths.
CHATTANOOGA, - - - TENN.

1871 IMPORTANT 1891
To Architects, Engineers and Contractors.

"SAYLOR'S AMERICAN PORTLAND CEMENT" has been on the American market for twenty years in successful competition to all Imported Portland Cements. Buyers will save money and secure the best results by using this brand. Sold in barrels and cotton or paper sacks.

JOHNSON & WILSON, GENERAL SELLING AGENTS,
Aldrich Court, 15 Broadway, New York.
Correspondence solicited. Note carefully the following letter:

A. J. Swift, Chief Engineer. Albany & Susquehanna / Rensselaer & Saratoga / New York & Canada and Adirondack Railway. } Railroads.
Delaware & Hudson Canal Co., Office of the Chief Engineer, Northern Railroad Department, ALBANY, N. Y., Jan. 21, 1891.

MESSRS. JOHNSON & WILSON, ALDRICH COURT, NEW YORK.
GENTLEMEN: In answer to your inquiry as to the characteristics and merits of the "Saylor's American Portland Cement," which we have purchased from you during the last two years, I am glad to be able to say that it has proved entirely satisfactory, and, in my opinion, is as desirable for railroad engineering structures as any imported Portland cement which we have used, and this statement covers all the best known brands in use. We have had occasion, during the past three months, to remove abutments in which your cement was used, and therefore I am able to say, with a full knowledge of the facts, that the results have been eminently satisfactory. We have used it in the coldest weather during the past two years with a large percentage of salt, and have found it entirely satisfactory. It sets quickly, which is, of course, a matter of great importance where the traffic of the railroad has to be carried on green masonry, and its hydraulic properties have been thoroughly tested in coffer-dams where we have used it, and have proved to be excellent.
We propose to continue using it as our standard cement until something equally good and less expensive shall appear upon the market, and this we fail to find as yet.
It is, in my opinion, the cheapest high-class cement in use, and far superior in every desirable characteristic to all other brands of natural cements.
Yours very truly,
[Copy] A. J. SWIFT, Chief Engineer.

NOTE.—The Delaware & Hudson Canal Co. have used six thousand (6,000) barrels of "Saylor's Portland Cement" to May 1, 1891. Put up in strong paper bags, saving 15 per cent. on the cost in barrels.

U. S. ENGINEER OFFICE, 106 MADISON St., Memphis, Tenn., May 20, 1891.—Sealed proposals, in triplicate, will be received at this office until noon of June 10, 1891, for furnishing and delivering material as follows: About 40,000 cubic yards stone, 57,000 cords brush, 11,000 cords poles, 312,000 lbs. wire strand, 415,000 lbs. wire, 18,400 ft. wire cable, 26,000 lbs. spikes, 4,000 lbs. clevises, 4,200 lbs. staples, 22,000 lbs. rope. The attention of bidders is invited to Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Blank proposals and all necessary information can be obtained by application to this office. C. McD. TOWNSEND, Capt. of Engrs., U. S. A. 21-3t.

Commonwealth of Massachusetts

Metropolitan Sewerage Commissioners. Notice to contractors.

Sealed bids for building Section 2 of the Metropolitan Sewerage System on Deer Island and Section 12 in Chelsea, in accordance with the form of contract and specifications to be furnished by the Board of Metropolitan Sewerage Commissioners, will be received by said board at its office, 93 Lincoln street, Boston, Mass., until 12 o'clock M. of SATURDAY, June 13, 1891.

No bid will be received unless accompanied by a certified check for the sum of $1,000.

All bids must be made upon the blank forms furnished by the board.

The external diameter of the sewer on these sections is approximately from 10 to 13 ft.

Some other particulars are approximately as follows:

Section.	Length, ft.	Average depth, ft.	Cu. yds., masonry.
2	2100	19	4800
12	3050	27	5500

Plans can be seen and specifications and form of contract can be obtained at the above office.

Each bidder is required to make a statement indicating what sewer and similar work he has done, and to give references that will enable the board to judge of his business standing.

The board reserves the right to reject any and all bids.

HOSEA KINGMAN,
TILLY HAYNES,
ROBERT T. DAVIS,
} Board of Metropolitan Sewerage Commissioners of Massachusetts.
HOWARD A. CARSON, Chief Engineer. 21-4t

Notice to Contractors.

BUILDING SEWERS AND APPURTENANCES (ORANGE, N. J.)

Sealed proposals for the construction of approximately one hundred and three thousand (103,000) feet of pipe sewers and eleven thousand (11,000) feet of brick sewers, and appurtenances, will be received at the office of the City Clerk, Orange, N. J., until noon of June 8, 1891. Plans and sections, proposal blanks and specifications can be seen at the office of the engineer in charge of the work, Orange, N. J., or corner of Broad and Market streets, Newark, N. J. A certified check must accompany each proposal. No proposal may be withdrawn. A bond satisfactory to the Common Council for twenty-five (25) per cent. of the contract price will be required of the successful bidder.

The Common Council expressly reserves the right to reject any or all bids.

CARROL PH. BASSETT,
Chief Engineer.
FRANKLIN P. DOTY, Chairman;
MARTIN A. BRENNAN,
WILLIAM HALEY,
JOHN SEYMOUR,
WILLIAM HARRINGTON,
Sewerage Committee.
HORACE STETSON, City Clerk.
No. 238 Main St., Orange, N. J.
Dated, Orange, N. J., May 12, 1891. 20-4t

Peru, Ill., Water-Works.

PROPOSALS WILL BE RECEIVED UNtil 6 o'clock P. M. on the 6th day of June, A. D. 1891, for a water-works system for the city of Peru, Ill.

The work will consist of furnishing and erecting two 1,000,000-gall. compound duplex pumping engines, two boilers, water tower, hydraulic valves and about nine miles of pipe, to be laid, etc. Payments will be made as follows: $30,000 upon completion of the works, and the balance in $6,000 yearly equal installments to bear 5 per cent. interest per annum.

Proposals shall be addressed to G. Gmelich, Mayor, Peru, Ill., and marked Proposals for Complete Water-works System.

Plans and specifications on file with the City Clerk at Peru, Ill., and at the office of Chas. H. Ledlie, 417 Olive St., St. Louis, Mo.

Right is reserved to reject any and all bids.
G. GMELICH, Mayor,
CHAS. W. LEDLIE, Consulting Engineer.
21-2t

Port Clinton Short Line Railway.

SEALED PROPOSALS WILL BE RECEIVED at this company's office, in Port Clinton, Ottawa Co., O., until 11 A. M. on Monday, June 8, 1891, for supplying all rails, fastenings and ties for and laying 12 miles of standard track from Short Line Junction to Port Clinton. The work is to be completed within 90 days from June 8, 1891, and payment for all of same to be made in the company's first mortgage bonds at 90 cents on the dollar. All rights of way now secured, and grading, bridging and culverts done ready for track-laying.

The first mortgage will cover the entire 12 miles of property and valuable terminals, and the whole issue of bonds secured by same will be fixed at $100,000, bearing 6% interest.

Specifications and form of bid on application.

Right reserved to reject any and all proposals.

EDGAR H. BRENNAN,
President and Engineer.
PORT CLINTON, Ottawa Co., O.,
May 13, 1891. 21-3t

To Dredging Contractors—Bids

wanted to put 45,000 yards earth filling behind sea wall at Governor's Island. Reply by letter to 2 Palisade Ave., Yonkers, or apply in person on the Island. BREUCHAUD, PENNELL & CO. 22-2t

Proposals.

OFFICE WATER-WORKS,
SAVANNAH, GA., May 21, 1891.

SEALED proposals will be received by the City of Savannah, Georgia, until eleven (11) o'clock A. M., July 15th, 1891, for furnishing and constructing Two (2) High-Duty Pumping Engines, each having a capacity of Ten Million (10,000,000) U. S. gallons per day, and the necessary Boilers and other appurtenances pertaining to a pumping plant. All to be in accordance with general specifications on file in the Water Office at Savannah, Ga., or which, with all other information, can be obtained from Thomas T. Johnston, Consulting Engineer, at room No. 29, No. 171 La Salle street, Chicago, Illinois.

Proposals must be made in accordance with the aforesaid general specifications. No proposal will be considered unless the party offering it can furnish evidence satisfactory to the Mayor and Board of Aldermen of the City of Savannah of his ability, and that he has the necessary facilities, together with sufficient pecuniary resources, to fulfill the conditions of the contract and the specifications, provided such contract should be awarded h'm.

The right to reject any and all proposals not deemed for the best interest of the city is reserved.

JAMES MANNING,
22-4t Superintendent.

Niles, O., Water-Works.

Notice to Contractors.

SEALED PROPOSALS WILL BE RECEIVED by the Village Council of Niles, Trumbull County, Ohio, UNTIL NOON, JUNE 30TH, 1891, for furnishing material and constructing water-works for said village as follows:

One infiltration or supply basin, one building and one chimney, one storage reservoir, two pumping engines of 1,000,000 gallons each in 24 hours. Bids will be received for compound condensing and compound non-condensing machinery. Also two boilers for said works, including engine foundations, boiler setting, together with all pipes and fixtures complete.

Also the furnishing of 600 ft. of 14-in., 150 ft. of 12-in., 2,400 ft. of 10-in., 16,500 ft. of 8-in., 14,900 ft. of 6-in. and 12,750 ft. of 4-in. cast-iron coated water pipe, aggregating about 810 tons of 2,000 pounds. Also about 22 tons of special castings; also the laying of pipe and specials. Also the furnishing of 80 fire hydrants, 56 stop valves and 56 valve boxes, and setting same.

Bids will be received for the Water-Works System complete, or for any department of work, or material separately. The Council reserves the right to reject any or all bids. Plans and detailed drawings can be seen at the office of the Village Council on and after June 10. Specifications furnished contractors by the consulting engineer or the village clerk. Proposals must be indorsed "Water-Works Proposal."

J. B. STRAWN, Consulting Engineer,
273 Lincoln Ave., Salem, O.
M. J. FLAHERTY, Village Clerk,
Niles, O.
NILES, O., May 26, 1891. 22-5t

Sealed Proposals will be received

at this office until July 6th, 1891, at 12 M., for the building of a sewerage system for the city of Vicksburg, Miss., as per plans and specifications now on file in the office of the City Clerk. The Board of Mayor and Aldermen reserve the right to reject any and all bids.

R. V. BOOTH, Mayor.
VICKSBURG, Miss., May 25th, 1891. 22-3t

STONE AND DREDGING AT FLUSHING Bay, N. Y.—Engineer Office, U. S. Army, Room H 7, Army Building, 39 Whitehall Street, New York, N. Y., May 23, 1891.—Sealed proposals, in triplicate, for stone and dredging at Flushing Bay, N. Y., will be received at this office until twelve (12) o'clock noon on Monday, June 22, 1891. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on the envelope "Official Business." D. C. HOUSTON, Colonel of Engineers. 21-4t

[For other Proposals see following pages.

U. S. ENGINEER OFFICE, 106 MADISON St., Memphis, Tenn., May 20, 1891.—Proposals will be received at this office up to noon of June 8, 1891, for constructing and delivering ten gunwale barges and one floating drydock. Attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 24, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Blank forms, drawings and all necessary information can be obtained by application to this office. C. McD. TOWNSEND, Capt. of Engrs., U. S. A. 21-3t

U. S. ENGINEER OFFICE, ARMY BUILDing, New York, May 23, 1891. Sealed proposals, in triplicate, will be received at this office until 12 o'clock noon, June 24, 1891, for the construction and delivery of one iron roof truss for torpedo shed at Sandy Hook, N. J. The attention of bidders is invited to acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes-at-Large. For specifications, blank forms, and all information, apply to the undersigned, G. L. GILLESPIE, Lieut.-Col. of Engineers. 23-3t

Rutland, Vt., Water-Works.

SEALED PROPOSALS for building a reservoir of about six million gallons capacity will be received by the Water Commissioners of Rutland, Vt., until noon of Monday, June 15, 1891. The work comprises about 17,000 cubic yards earth excavation and embankment, 1,300 cubic yards cement masonry, 10,000 brick in place and is to be completed before Oct. 1, 1891. Plans and specifications may be seen at office of Chappell & Burke, Civil Engineers, Rutland, Vt. The right to reject any or all bids is here by reserved.

GEO. E. ROYCE,
Chairman Water Com.

RUTLAND, Vt., June 1, 1891. 23-1t

Street Paving.

SEALED PROPOSALS for the grading, preparation of foundation and paving with firebrick, furnishing curbing and setting the same on a part of Main Street, in the Borough of Greensburg, Pa., will be received by the Board of Burgesses of said Borough until 8 P. M., June 15, 1891. Profile and specifications can be seen on file at the office of Freeman C. Gay, Chief Burgess. The right is reserved to reject any and all proposals.

By order of Board of Burgesses.
Attest: A. G. MARSH, Clerk. 25-1t

STOW FLEXIBLE SHAFT.

Invented and Manufactured by the

Stow Manufacturing Co.,
BINGHAMTON, N. Y.

Established 1875.

For tapping and reaming stay bolt Holes in BOILERS.

Portable Drilling

CENTRAL I.C. R.R. ROUTE

ILLINOIS CENTRAL RAILROAD.

THE Popular Short Line BETWEEN

CHICAGO, ROCKFORD, FREEPORT, DUBUQUE,
WATERLOO, SIOUX CITY AND SIOUX FALLS.

PULLMAN SLEEPERS ON ALL TRAINS

RECLINING CHAIR CARS. ON ALL TRAINS.

C. A. BECK, General Manager. T. J. HUDSON, Traffic Manager.
E. C. MARKHAM, Ass't Traffic Manager. A. H. HANSON, Gen'l Passenger Agent.

THE CURTIS BALANCED STEAM TRAP.

THE CURTIS REGULATORS

Cheapest, Most Durable, Most Powerful. Have stood the test of Seven Years. WITHOUT EQUALS.

OUR PATENTS:—Damper Regulators, Steam Pressure Regulators, Pressure Regulators for Steam, Water and Air; Steam Traps, Return Traps, Separators, Balanced Steam Traps, Thermostatic Damper Regulators for Residences and Public Buildings, and other Specialties for the Use and Saving of Steam.

FULL INFORMATION CHEERFULLY FURNISHED BY

GENERAL AGENCIES:
NEW YORK, 109 Liberty st. CHICAGO, 218 Lake st.
PHILADELPHIA, 2035 N. Front st.
MINNEAPOLIS, 210 S. Third st. DENVER, COL., Amphre Bldg.

THE CURTIS REGULATOR CO.,
63 Beverly Street, Boston, Mass.

Contractors, Bridge Builders, Railroad Property Managers,

It means much annoyance, loss of time and money, if you use common Tackle Blocks. They always break, give trouble, etc., just when you want them most. So, isn't it?

The **STAR BRAND** Always **SAFE, SURE.**

SPECIALTIES:—

Improved Self-Adjusting Five Roller Bush Blocks. Improved Self-Lubricating Metaline Blocks. Improved Self-Locking Link Snatch Blocks. Improved Wrought Iron Blocks with Rolled Edges to save wear of rope. Batt's Patent Differential Hoists. Always call for STAR BRAND. All goods made on honor. None but best materials used.

FULL INFORMATION CHEERFULLY FURNISHED BY THE

BOSTON AND LOCKPORT BLOCK CO., 162 Commercial St., Boston, Mass.

Loud's Patent Hand Power Pumps---Pumps water containing everything but rocks. Send for Catalogue.

DYCKERHOFF PORTLAND CEMENT

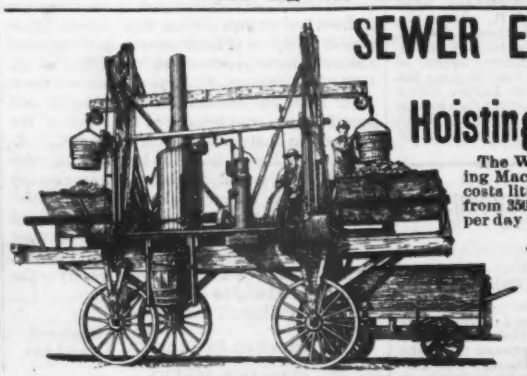
Is superior to any other Portland Cement made. It is very finely ground, always uniform and reliable, and of such extraordinary strength that it will permit the addition of 25 per cent more sand, etc., than other well known Portland Cements, and produce the most durable work. It is unalterable in volume and not liable to crack.

Six thousand barrels have been used in the foundations of the Bartholdi Statue of Liberty and it has also been used in the construction of the Washington Monument at Washington.

Circular with Testimonials and Tests sent on application.

E. THIELE, 73 William Street, NEW YORK
Sole Agent, United States.

SEWER EXCAVATING AND Hoisting Apparatus.



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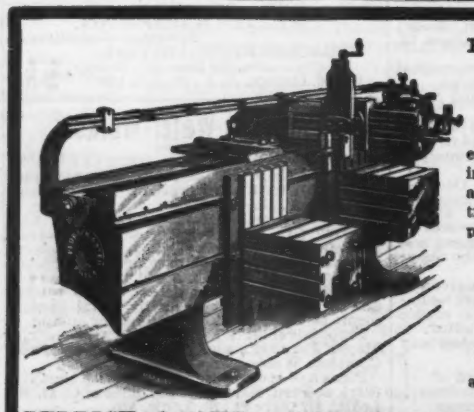

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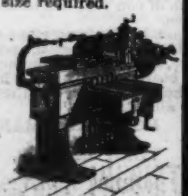

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